Article

Global Environmental Regulation: Instrument Choice in Legal Context

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I. INTRODUCTION

Contests to crown the best regulatory instrument have been the ceaseless sport of environmental law. Fans of command-and-control technology requirements[1] have wrestled with devotees of incentive-based approaches such as taxes and tradeable allowances.[2] Meanwhile, an equally spirited rivalry has been pursued within the incentive-based camp, as advocates of Pigouvian price-based tools (liability rules and taxes)[3] have squared off against supporters of Coasean quantity-based tools (property rules and tradeable allowances).[4] Seminal contributions have attempted to

1. *See, e.g.*, Howard Latin, *Ideal Versus Real Regulatory Efficiency: Implementation of Uniform Standards and 'Fine-Tuning' Regulatory Reform*, 37 STAN. L. REV. 1267 (1985); Thomas O. McGarity, *Radical Technology-Forcing in Environmental Regulation*, 27 LOY. L.A. L. REV. 943 (1994); Sidney A. Shapiro & Thomas O. McGarity, *Not So Paradoxical: The Rationale for Technology-Based Regulation*, 1991 DUKE L.J. 729.

2. *See, e.g.*, BRUCE A. ACKERMAN ET AL., THE UNCERTAIN SEARCH FOR ENVIRONMENTAL QUALITY (1974); FREDERICK R. ANDERSON ET AL., ENVIRONMENTAL IMPROVEMENT THROUGH ECONOMIC INCENTIVES (1977); STEPHEN BREYER, REGULATION AND ITS REFORM 271-84 (1982); ALLEN V. KNEESE & CHARLES L. SCHULTZE, POLLUTION, PRICES, AND PUBLIC POLICY 69-84 (1975); CHARLES L. SCHULTZE, THE PUBLIC USE OF PRIVATE INTEREST 54 (1977); Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333 (1985) [hereinafter Ackerman & Stewart, *Reforming*]; Richard B. Stewart, *Controlling Environmental Risks Through Economic Incentives*, 13 COLUM. J. ENVTL. L. 153 (1988); T.H. Tietenberg, *Economic Instruments for Environmental Regulation*, 6 OXFORD REV. ECON. POL'Y 17 (1990).

Much environmental law enacted in the 1970s employed the technology-based approach, but the momentum has swung in recent years toward incentive-based approaches. *See generally* ORGANISATION FOR ECON. COOPERATION AND DEV. (OECD), ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL PROTECTION (1989); Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 171 (1988) [hereinafter Ackerman & Stewart, *Democratic Case*]; Daniel J. Dudek, Richard B. Stewart, & Jonathan B. Wiener, *Environmental Policy for Eastern Europe: Technology-Based Versus Market-Based Approaches*, 17 COLUM. J. ENVTL. L. 1 (1992); Robert W. Hahn & Robert N. Stavins, *Incentive-Based Environmental Regulation: A New Era from an Old Idea?*, 18 ECOLOGY L.Q. 1 (1991).

3. For the initial suggestion, see A.C. PIGOU, THE ECONOMICS OF WELFARE 172-203 (4th ed. 1932). For more recent treatments, see, for example, WILLIAM J. BAUMOL & WALLACE E. OATES, THE THEORY OF ENVIRONMENTAL POLICY 21-22, 29 (Cambridge Univ. Press 2d ed. 1988) (1975); and LOUIS KAPLOW & STEVEN SHAVELL, ON THE SUPERIORITY OF CORRECTIVE TAXES TO QUANTITY REGULATION (National Bureau of Econ. Research Working Paper No. 6251, 1997).

4. For Coase's original proposal, see R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960), which advocates a property-based approach to pollution control. Others have developed the idea further. *See, e.g.*, J.H. DALES, POLLUTION, PROPERTY & PRICES (1968) (elaborating on the tradeable allowances approach); T.H. TIETENBERG, EMISSIONS TRADING: AN EXERCISE IN REFORMING POLLUTION POLICY (1985) (evaluating an emissions trading program); Thomas D. Crocker, *The Structuring of Atmospheric Pollution Control Systems*, *in* THE ECONOMICS OF AIR POLLUTION 61, 81-84 (Harold Wolozin ed., 1966) (suggesting tradeable pollution allowances); W. David Montgomery, *Markets in Licenses and Efficient Pollution Control Programs*, 5 J. ECON. THEORY 395 (1972) (providing a theoretical foundation for a proposal to establish a market in pollution licenses); Thomas H. Tietenberg, *Transferable Discharge Permits and the Control of Stationary Source Air Pollution*, 56 LAND ECON. 391 (1980) (discussing the implementation of transferable discharge permits for air pollution).

referee when the law should employ liability rules versus property rules and emissions taxes versus tradeable emissions allowances.[5]

Now the Olympics of instrument choice are underway, the contest joined at the international level. The game is to find the best regulatory instruments to respond to global environmental problems such as greenhouse climate change, stratospheric ozone depletion, and biodiversity loss. All the regulatory instruments have entered the field,[6] each with its avid fans: technology-based requirements,[7] harmonized policies (under which international law would dictate specific policy measures to be adopted by all countries),[8] pollution taxes,[9] fixed performance targets,[10] and tradeable allowances.[11]

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5. *See, e.g.*, Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972); Louis Kaplow & Steven Shavell, *Property Rules Versus Liability Rules: An Economic Analysis*, 109 HARV. L. REV. 713 (1996); A. Mitchell Polinsky, *Controlling Externalities and Protecting Entitlements: Property Right, Liability Rule, and Tax-Subsidy Approaches*, 8 J. LEGAL STUD. 1 (1979); Carol M. Rose, *Rethinking Environmental Controls: Management Strategies for Common Resources*, 1991 DUKE L.J. 1; Martin L. Weitzman, *Prices vs. Quantities*, 41 REV. ECON. STUD. 477 (1974). *See generally* Peter Bohm & Clifford S. Russell, *Comparative Analysis of Alternative Policy Instruments*, *in* 1 HANDBOOK OF NATURAL RESOURCE AND ENERGY ECONOMICS 395 (Allen V. Kneese & James L. Sweeney eds., 1985).

6. For useful surveys, see B.S. Fisher et al., *An Economic Assessment of Policy Instruments for Combatting Climate Change*, *in* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 1995: ECONOMIC AND SOCIAL DIMENSIONS OF CLIMATE CHANGE 397 (James P. Bruce et al. eds., 1996) [hereinafter IPCC ECON. 1995]; and Robert N. Stavins, *Policy Instruments for Climate Change: How Can National Governments Address a Global Problem?*, 1997 U. CHI. LEGAL F. 293.

7. *See, e.g.*, ENVIRONMENTAL WORKING GROUP, BLIND SPOT: THE BIG THREE'S ATTACK ON THE GLOBAL WARMING TREATY (1997) (advocating more stringent automobile fuel efficiency standards to reduce greenhouse gas emissions); Owen McIntyre & Thomas Mosedale, *The Precautionary Principle as a Norm of Customary International Law*, 9 J. ENVTL. L. 221, 236-37 (1997) (describing advocacy of "variations on the theme of 'best available technology' (BAT)" as a centerpiece of the "precautionary principle" and its embodiment in several international treaties, including the Framework Convention on Climate Change); Jae Edmonds & Marshall Wise, Exploring a Technology Strategy for Stabilizing Atmospheric CO_2 (Aug. 1, 1997) (unpublished manuscript, on file with *The Yale Law Journal*).

8. *See, e.g.*, Thomas C. Schelling, *The Cost of Combating Global Warming*, FOREIGN AFF., Nov.-Dec. 1997, at 8.

9. *See, e.g.*, WILLIAM R. CLINE, THE ECONOMICS OF GLOBAL WARMING 346-57 (1992); WARWICK J. MCKIBBIN & PETER J. WILCOXEN, A BETTER WAY TO SLOW GLOBAL CLIMATE CHANGE (Brookings Inst. Policy Brief No. 17, 1997); WILLIAM A. PIZER, PRICES VS. QUANTITIES REVISITED: THE CASE OF CLIMATE CHANGE (Resources for the Future Discussion Paper No. 98-02, 1997); Richard N. Cooper, *Toward a Real Global Warming Treaty*, FOREIGN AFF., Mar.-Apr. 1998, at 66; James M. Poterba, *Global Warming: A Public Finance Perspective*, 7 J. ECON. PERSP. 47 (1993).

10. *See* Kevin Sullivan & Mary Jordan, *The Challenge: Incorporating Many Nations' Needs into One Treaty*, WASH. POST, Nov. 15, 1997, at A1 (describing European proposals for fixed national emissions targets).

11. Early proposals include MICHAEL GRUBB, THE GREENHOUSE EFFECT: NEGOTIATING TARGETS 41 (1989); Richard B. Stewart & Jonathan B. Wiener, *A Comprehensive Approach to Climate Change: Using the Market To Protect the Environment*, AM. ENTERPRISE, Nov.-Dec. 1990, at 75 [hereinafter Stewart & Wiener, *Climate Change*]; Daniel J. Dudek, Marketable Instruments for Managing Global Atmospheric Problems (July 7-11, 1987) (unpublished manuscript, on file with *The Yale Law Journal*); and Daniel J. Dudek, International Trading in

Yet this debate has been conducted without much regard for whether the comparison of regulatory instruments needs to be different at the global level than at the national level. The question addressed in this Article is whether differences between the legal frameworks now in force at the national versus global levels imply different considerations for instrument choice. More generally, the question is whether the underlying legal framework of any polity—national, global, or local—affects its choice of optimal regulatory instrument. This Article argues that underlying legal institutions do matter in the choice among regulatory instruments, and that global environmental regulation must therefore be conceived differently from national environmental regulation. At least for the sport of regulatory choice, the Olympic rules are different from the rules in national competitions, and as a result the presumptive winners differ. The economics of instrument choice are embedded in and contingent on the underlying legal system.[12]

As a first principle, there is no single regulatory instrument that is "best" for all purposes. Each instrument has its strengths and weaknesses. Like the tennis player who performs best on clay or grass, each regulatory

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Greenhouse Gas Permits (1990) (unpublished manuscript, on file with *The Yale Law Journal*). More recent analyses include Adam L. Aronson, *From "Cooperator's Loss" to Cooperative Gain: Negotiating Greenhouse Gas Abatement*, 102 YALE L.J. 2143, 2160-74 (1993); Dudek et al., *supra* note 2, at 33 n.81; Alan Manne & Richard Richels, *The Berlin Mandate: The Costs of Meeting Post-2000 Targets and Timetables*, 24 ENERGY POL'Y 205-10 (1996); and Richard B. Stewart & Jonathan B. Wiener, *The Comprehensive Approach to Global Climate Policy: Issues of Design and Practicality*, 9 ARIZ. J. INT'L & COMP. L. 83, 103-10 (1992) [hereinafter Stewart & Wiener, *Global Climate Policy*]. Over 2000 economists, including several Nobel laureates, have endorsed this approach. *See* Peter Passell, *Yawn. A Global Warming Alert. But This One Has Solutions*, N.Y. TIMES, Feb. 13, 1997, at D2 (discussing economists' statements on global warming); Letter from Kenneth J. Arrow, Professor, Stanford Univ., et al., to Members of the American Economic Association (attaching a statement by over 2000 economists endorsing international tradeable allowances to address global greenhouse gas emissions) (Jan. 3, 1997) (on file with *The Yale Law Journal*). *The Economist* magazine has lauded tradeable emissions permits as "a great leap forward in global environmental thinking." *The Kyoto Compromise*, ECONOMIST, Dec. 13, 1997, at 16; *see also Money To Burn? Controlling Global Warming Will Be Expensive. Emissions Trading Is an Intelligent Way To Lower the Cost*, ECONOMIST, Dec. 6, 1997, at 86 (endorsing emissions trading).

12. This Article therefore can be seen as both an extension of law and economics methods to the global level and a reinvigoration of the "law" in law and economics—toward a partnership of law *and* economics, rather than merely an understanding of law *as* economics. *Cf. infra* note 220 and accompanying text (quoting James Buchanan urging economists to take account of legal structures). The words of Harvard economist Robert Stavins in this same context are significant:

> [S]ome of the greatest barriers to progress in dealing with the threat of global climate change are political hurdles domestically and institutional challenges internationally, [so] we should be modest—to say the least—about the likelihood of analytical dominance by economics. . . . [T]his is an area where economists can learn from their colleagues in political science and law. Over the past several decades, legal scholarship and political science have been significantly influenced by economics. Now, global climate change policy—with its centrally important political and institutional features—presents an opportunity for that favor to be repaid.

Stavins, *supra* note 6, at 327. In this Article, I attempt a partial repayment in what one hopes will be a continuing exchange.

instrument has its best policy terrain; pragmatic choice depends on context.[13]

Nonetheless, after thirty years of head-to-head competition in both theory and practice, analysts appear to have converged on three presumptions. The first is that incentive-based instruments such as taxes and tradeable allowances should generally be chosen over technology requirements and fixed emissions standards because the incentive-based instruments are typically far more cost-effective and innovation-generating than their alternatives.[14] The second presumption is that subsidies are inefficient because they create perverse incentives.[15] The third presumption is that, among the incentive instruments, the price-based tax and liability rule instruments—which set a price on emissions and let sources adjust the quantity they emit—will typically be superior to the quantity-based tradeable allowance and property rule instruments—which set the quantity of emissions and let sources bargain over price. This is chiefly because the price instruments are thought to perform better under uncertainty, to raise valuable revenues, and to avoid transaction costs.[16] In a recent comparative analysis, Professors Kaplow and Shavell conclude that "there is a prima facie case favoring liability rules over property rules for controlling harmful externalities"[17] and that likewise "pollution taxes are preferable to the system of tradeable pollution rights."[18] Thus, the standard analysis crowns taxes as the presumptive first choice for optimal environmental regulation.

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13. The notion of "matching" and "mismatching" regulatory instruments to policy contexts is articulated in BREYER, *supra* note 2, at 191-96. As Robert Stavins observes:

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

Robert N. Stavins, *Introduction* to PUBLIC POLICIES FOR ENVIRONMENTAL PROTECTION (Paul R. Portney & Robert N. Stavins eds., 2d ed. forthcoming 1999); *see also* BAUMOL & OATES, *supra* note 3, at 3 ("[T]here exists a substantial range of policy instruments, each with its particular strengths and weaknesses. An enlightened and effective program of environmental management must incorporate these instruments into an integrated set of policies that draws on the strengths and, where possible, avoids the weaknesses of the individual policy measures."); A. Mitchell Polinsky, *Resolving Nuisance Disputes: The Simple Economics of Injunctive and Damage Remedies*, 32 STAN. L. REV. 1075, 1110-11 (1980) (noting that depending on assumptions, either liability rules or property rules might be preferred).

14. A recent review of the literature on instrument choice proclaims "an emerging scholarly consensus that incentive-based regulatory systems are often the superior approach." Jon D. Hanson & Kyle D. Logue, *The Costs of Cigarettes: The Economic Case for Ex Post Incentive-Based Regulation*, 107 YALE L.J. 1163, 1174 (1998).

15. *See infra* Subsection III.C.2.

16. *See infra* Subsection III.C.3.

17. Kaplow & Shavell, *supra* note 5, at 721.

18. *Id.* at 750.

As one environmental economist puts it, "[O]f all policy instruments to accomplish environmental improvement, economists hold pollution taxes in nearly reverential regard."[19]

This Article reevaluates these presumptions about instrument choice when the legal context shifts from the national to the global level. The Article shows that the presumption favoring environmental taxes depends on the assumptions that the regulator can compel polluters to comply by fiat and that the regulator can impose the instrument directly on polluters without an intermediate level of government in the way.[20] But neither of these assumptions—coercive fiat or unitary regulation—is valid in the global legal context. International treaties depend on countries' voluntary assent and on implementation through national governments.[21] Most analyses of instrument choice for global environmental regulation neglect these fundamental differences between national and global legal systems.

The requisite investigation is a comparative institutional analysis of regulatory instrument choice under alternative legal frameworks.[22] This Article therefore examines the impact on regulatory instrument choice of two basic legal parameters that differ between the national and global settings: voting rules and implementation structures.[23] To explore the role of the legal framework, I conduct an analysis of the degree to which the relative merits of the regulatory instruments are sensitive to changes in the underlying legal framework of government. Put another way, I test a model in which the dependent variable is the relative preference among the regulatory instruments and in which the independent variables include the legal framework parameters as well as the conventionally studied policy attributes such as cost-effectiveness. Thus, I attempt to control for the numerous other attributes that differentiate the regulatory instruments and to isolate the impact of the underlying legal system's parameters on the relative performance of the regulatory instruments. In short, I test optimal instrument choice as a function of the legal framework.

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19. Frank S. Arnold, *The Economist's Perspective: Why There Are No Pollution Taxes*, ENVTL. F., Mar.-Apr. 1998, at 14.

20. *See infra* Section III.A.

21. *See infra* Parts IV, V.

22. This exercise attempts to compare alternative regulatory instruments in their real and imperfect institutional contexts, rather than comparing real regulatory instruments with "nirvana" ideals. *Cf.* NEAL K. KOMESAR, IMPERFECT ALTERNATIVES: CHOOSING INSTITUTIONS IN LAW, ECONOMICS, AND PUBLIC POLICY 3, 5 (1994) (characterizing comparative institutional analysis as a choice among the strengths and weaknesses of inevitably imperfect alternatives); Harold Demsetz, *Information and Efficiency: Another Viewpoint*, 12 J.L. & ECON. 1, 1 (1969) (distinguishing the "nirvana approach" from a "comparative institution approach in which the relevant choice is between alternative real institutional arrangements" (emphasis omitted)).

23. The voting rule and the implementation structure are certainly not the only two parameters that distinguish the global context from the national context and the idealized world of academic analysis, but they are two of the most important and two of the most amenable to analysis.

Part II of this Article describes key challenges for global environmental regulatory design. Part III reviews the instruments available in the "global regulator's toolbox" and summarizes the standard analysis of the choice among these instruments, under the unrealistic but standard assumption of "Unitary Fiat." This Part sets the baseline for the subsequent investigation of instrument choice when the legal framework varies.

Part IV examines the choice of regulatory instruments when the voting rule varies.[24] I show that, all other policy attributes held equal, as the voting rule becomes less coercive (moving from Autocratic Fiat to Majority rule to Voluntary Assent), the relative attractiveness of quantity-based (tradeable allowance) over price-based (tax) instruments rises. Without coercion, participation must be attracted. Part IV shows that "participation efficiency" is a crucial attribute of instrument choice at the global level, and, as a corollary, that environmental regulation under the Voluntary Assent rule must be based on a "beneficiaries pay" principle rather than a "polluters pay" principle. Part IV then argues that the necessity of actual side payments from beneficiaries to polluters under the Voluntary Assent voting rule, coupled with the distortionary effects of such side payments, confers a significant advantage on quantity-based instruments such as tradeable allowances. Part IV recognizes that other attributes of regulatory choice remain important under Voluntary Assent and could still render another regulatory instrument superior to tradeable allowances for protecting the global environment. Holding such other attributes equal, however, the move from Fiat to Voluntary Assent gives quantity-based tradeable allowances an important presumptive advantage.[25]

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24. I take the global voting rule as given and do not argue that one or the other voting rule is preferable for global policy. I do not argue here, for example, that the solution to global environmental problems is to replace the Voluntary Assent rule for treaties with a coercive global government that can enforce its regulations against dissenters. Such a move would render the national and global legal frameworks more equivalent and thereby evade the question analyzed here: whether the choice among regulatory instruments is affected by variations in the legal framework. The present challenge of global environmental protection is to select the optimal regulatory instrument to be deployed *given* the particular legal framework that prevails at the global level. Whatever the merits of alternative voting rules, the Voluntary Assent rule in force at the global level is unlikely to change quickly. *See infra* note 221.

25. Part IV acknowledges that the real international legal system does not employ a pure Voluntary Assent rule (nor does the real national legal system employ a pure Majority rule). It analyzes the choice of instruments under the Voluntary Assent rule and also addresses the qualifications necessary to account for a more textured depiction of international law in which some coercive pressures may be brought to bear on dissenting nations. Along the spectrum of voting rules, the international legal system still remains far less coercive than Majority rule and enormously less coercive than Fiat. Moreover, considerations of fairness and effectiveness counsel against application of coercive pressures to address global environmental problems. Thus, the central conclusion—the presumptive superiority of tradeable allowances over taxes at the global level—remains robust.

Part V addresses the choice of regulatory tools under different implementation structures.[26] I argue that, all other policy attributes held equal, as the implementation structure becomes increasingly jurisdictional (moving from unitary to federalist to fully jurisdictional), the relative attractiveness of tradeable allowances over taxes rises. To be sure, the jurisdictional structure poses impediments for allowance trading as well—indeed, for any regulatory instrument—but it poses relatively more intractable problems for taxes. Thus, I show that the jurisdictional structure gives quantity-based tradeable allowances an additional prima facie advantage over taxes at the global level.

Part VI presents the conclusions. First, the design of international environmental treaties—that is, global regulatory instrument choice—must be different from instrument choice at the national level. The Voluntary Assent voting rule in force at the global level puts a premium on attracting participation efficiently. At the same time, the jurisdictional implementation structure poses obstacles, especially to global environmental taxes. Taken together, these legal parameters imply a strong prima facie preference for employing tradeable allowances, rather than taxes, to address global environmental problems. This result contrasts with the standard presumption in favor of taxes in the academic literature, precisely because of the difference in voting rules and implementation structures obtaining at the global level.

Second, and more fundamentally, the underlying legal framework substantially affects the relative merits of alternative regulatory instruments. This more general conclusion is applicable to the choice of regulatory instruments by any polity, from the global community to the national legislature to the local neighborhood. It furnishes a new dimension for evaluating the merits of liability rules, property rules, taxes, tradeable allowances, and technology requirements. Any realistic analysis of the choice among regulatory instruments must account for the underlying legal framework; failure to do so can generate biased policy choices. The choice of optimal regulatory instrument cannot be universal; rather, it must be contextual and contingent on the particular legal institutions of each polity. In short, the law and economics of regulation cannot be all economics; legal institutions matter.

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26. I take the implementation structure as given and do not argue that one implementation structure or the other is preferable for global policy. This Article addresses not the choice of implementation structure, but the choice of regulatory instruments taking as given the prevailing implementation structure. Whatever the merits of alternative implementation structures—decentralized local regulation, unitary global regulation, or some mixed federalist system—the implementation structures in force at the national and global levels are basic features of their attendant legal systems and are unlikely to change quickly.

II. GLOBAL ENVIRONMENTAL PROTECTION

The choice of regulatory instrument depends fundamentally on the problem that is to be regulated. This Part describes the principal global environmental problems and highlights three key aspects that affect instrument choice: the global extent of environmental impacts, the global mobility of sources of environmental harm, and the diversity of national abatement costs and benefits. Among other points, this Part establishes the predicate for the imperative of attracting voluntary participation, the applications of which are analyzed in Part IV.

Choosing optimal environmental regulatory instruments at the global level is important because global environmental concern and regulatory activity are increasing.[27] Global environmental problems such as stratospheric ozone depletion, greenhouse climate change, and biodiversity loss have stimulated the adoption of a growing body of international environmental treaties.[28]

Stratospheric ozone depletion drew attention in 1974 when two chemists theorized that ostensibly inert chlorofluorocarbons (CFCs)[29] could break apart in the upper atmosphere and react with stratospheric ozone, thinning the ozone layer that protects the earth from solar ultraviolet (UV) radiation.[30] Increased UV-irradiance could lead to skin cancers, damage to crops and ocean life, and other risks.[31] By the mid-1980s, the accumulating observational evidence of actual ozone depletion was a key factor leading countries to adopt the 1985 Vienna Convention for the Protection of the

27. *See* Robert W. Hahn & Kenneth R. Richards, *The Internationalization of Environmental Regulation*, 30 HARV. INT'L L.J. 421, 423-27 (1989); Oran R. Young, *Introduction* to GLOBAL ENVIRONMENTAL CHANGE AND INTERNATIONAL GOVERNANCE 1, 1 (Oran R. Young et al. eds., 1996).

28. The United Nations now lists over 160 international environmental treaties. *See Register of International Treaties and Other Agreements in the Field of the Environment*, U.N. Environmental Programme, U.N. Doc. UNEP/GC.16/Inf.6 (1993).

29. CFCs had been invented in the late 1920s and were employed in numerous industries, notably refrigeration, air conditioning, and computer chip manufacturing, in part precisely because they were thought to be inert—that is, not reactive with other chemicals. *See* James K. Hammitt & Kimberly M. Thompson, *Protecting the Ozone Layer*, *in* THE GREENING OF INDUSTRY: A RISK MANAGEMENT APPROACH 43, 45-53 (John D. Graham & Jennifer Kassalow Hartwell eds., 1997); Daniel F. McInnis, *Ozone Layers and Oligopoly Profits*, *in* ENVIRONMENTAL POLITICS: PUBLIC COSTS, PRIVATE REWARDS 129, 131 (Michael S. Greve & Fred L. Smith, Jr. eds., 1992).

30. *See* Mario J. Molina & F.S. Rowland, *Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom Catalysed Destruction of Ozone*, 249 NATURE 810 (1974). Molina and Rowland pointed out that it was precisely the chemically inert nature of CFCs that prevented their destruction by other processes, so that CFCs endure in the atmosphere for decades or centuries until they ascend to the stratosphere where intense solar ultraviolet radiation can break down the CFC molecule, releasing the highly reactive chlorine ion. *See id.* at 810-11. In 1995, Rowland and Molina received the Nobel Prize in Chemistry for this work. *See* David L. Chandler, *MIT Scientist Shares Nobel for Identifying Ozone Damage*, BOSTON GLOBE, Oct. 12, 1995, at 1.

31. *See* Hammitt & Thompson, *supra* note 29, at 70-73.

Ozone Layer.[32] Shortly thereafter, the "ozone hole" was confirmed over Antarctica, indicating much more rapid ozone depletion than theoretical models had predicted.[33] This dramatic new evidence of ozone depletion, among other factors, spurred the adoption of the Montreal Protocol on Substances That Deplete the Ozone Layer in 1987.[34] As updated, the Montreal Protocol now requires full phaseout of CFCs and full or partial phaseouts of several other ozone-depleting substances by industrialized countries, and similar but less immediate controls on developing countries.[35]

The greenhouse effect is an atmospheric phenomenon distinct from stratospheric ozone depletion. Whereas ozone depletion allows more high-frequency ultraviolet radiation to penetrate the earth's atmosphere, the greenhouse effect traps more low-frequency infrared radiation (heat) within the earth's atmosphere. The role of trace gases such as water vapor and carbon dioxide (CO_2) in trapping heat near the earth's surface has long been recognized.[36] It is this background greenhouse effect that has made the Earth habitable for life, keeping the planet about thirty-three degrees

32. Mar. 22, 1985, 26 I.L.M. 1529 (entered into force Sept. 12, 1988) [hereinafter Vienna Convention]; *see* Hammit & Thompson, *supra* note 29, at 76.

33. Hammitt & Thompson, *supra* note 29, at 62-65. The more rapid depletion appears to be associated with extremely cold polar stratospheric clouds, where solid frozen crystals of water and chlorine can react with gaseous ozone in an unusual heterogeneous chemistry. *See id.* at 64-65; Mario J. Molina et al., *Antarctic Stratospheric Chemistry of Chlorine Nitrate, Hydrogen Chloride, and Ice: Release of Active Chlorine*, 238 SCIENCE 1253, 1256-57 (1987); Susan Solomon et al., *On the Depletion of Antarctic Ozone*, 321 NATURE 755 (1986).

34. Sept. 16, 1987, 26 I.L.M. 1550 (entered into force Jan. 1, 1989) [hereinafter Montreal Protocol]; *see* Hammit & Thompson, *supra* note 29, at 76. In addition to the scientific evidence of rapid ozone depletion, another factor apparently motivating the international regulatory effort was the preparation of a quantitative cost-benefit study by the Council of Economic Advisers that persuaded the Reagan administration that a phaseout of CFCs was worthwhile. *See* RICHARD BENEDICK, OZONE DIPLOMACY 63 (1991). Another important factor was the 1986 judgment of American CFC producers, who had previously opposed international regulation, that they should now support a global phaseout of CFCs. This decision was made perhaps because unilateral regulation by the United States seemed likely and global regulation would be painful but preferable to unilateral measures, and because the American producers perceived that they would enjoy a greater advantage over their competitors in selling CFC substitutes than in selling CFCs. *See* KAREN T. LITFIN, OZONE DISCOURSES 106-08 (1994); Hammit & Thompson, *supra* note 29, at 76; McInnis, *supra* note 29, at 145-50.

35. *See* ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 1275-88 (2d ed. 1996); Hammitt & Thompson, *supra* note 29, at 67 tbl.3.2.

36. *See* LYNNE M. JURGIELEWICZ, GLOBAL ENVIRONMENTAL CHANGE AND INTERNATIONAL LAW 16 n.29 (1996) (citing Jean Baptiste Fourier, *Les Temperatures du Globe Terrestre et des Espaces Planetaires*, 7 MEMOIRES DE L'ACADEMIE ROYALE DES SCIENCES DE L'INSTITUT DE FRANCE 569-604 (1824)); Svante Arrhenius, *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground*, 41 PHIL. MAG. & J. SCI. 237, 237 (1896) (noting that a "great deal has been written" on the greenhouse effect); Stephen H. Schneider, *The Greenhouse Effect: Science and Policy*, 243 SCIENCE 771 (1989) (noting that the background greenhouse effect that keeps the Earth warm is one of the "most well-established theories in atmospheric science").

centigrade warmer than it otherwise would be.[37] But concern about an "enhanced greenhouse effect" grew in the 1970s as atmospheric concentrations of CO_2, methane (CH_4), and other gases were observed to be rising steadily, almost undoubtedly due to anthropogenic emissions of such gases. The extent to which these rising atmospheric concentrations will change global temperatures, and the impact of such an enhanced greenhouse effect on sea levels, precipitation patterns, ocean currents, crop zones, and species habitats, remain much debated.[38] The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 to provide scientific and technical advice on the issue, and in 1990 the United Nations convened negotiations toward a Framework Convention on Climate Change (FCCC) that virtually all the world's heads of state signed at the Rio Earth Summit in June 1992.[39] The FCCC called on industrialized countries to take actions to limit their emissions of greenhouse gases (GHGs), with the "aim" of keeping these emissions no higher than their 1990 level in the year 2000.[40] In 1997, countries negotiated the Kyoto Protocol, which, when ratified, would set binding targets for industrialized countries to reduce their emissions roughly five percent below 1990 levels by the period 2008 to 2012.[41]

Concern about depletion of biological resources—and the loss of biological diversity—has also risen. Deforestation has accelerated and the planet's remaining forests are becoming more fragmented.[42] Meanwhile, fish populations are also under stress.[43] As fish stocks have been depleted, the attempt to maintain or increase the quantity of harvest has yielded a decreasing quality of harvest, an increasing investment of capital and effort

37. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE: THE IPCC SCIENTIFIC ASSESSMENT at xiv (1990).

38. *Compare* STEPHEN SCHNEIDER, GLOBAL WARMING (emphasizing the risks of anthropogenic global warming), *with* ROBERT C. BALLING, JR., THE HEATED DEBATE (1992) (doubting risks of significant anthropogenic global warning).

39. *See* United Nations Framework Convention on Climate Change, May 29, 1992, 31 I.L.M. 849 (entered into force Mar. 21, 1994) [hereinafter FCCC].

40. *See id.* at art. 4(2)(a)-(b), 31 I.L.M. at 856-57.

41. *See* Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, 37 I.L.M. 22 (opened for signature Mar. 16, 1998) [hereinafter Kyoto Protocol].

42. *See* WORLD RESOURCES INST., WORLD RESOURCES 1998-99, at 185-86 (1998); Walter Reid, *Strategies for Conserving Biodiversity*, ENVIRONMENT, Sept. 1, 1997, at 16, 20 ("[T]he current rate at which tropical forests are being lost [is] approximately 10 million hectares per year, or slightly less than 1%."). Note that deforestation is not a modern aberration: Human societies have cleared forests for centuries. *See* WORLD RESOURCES INST., *supra*, at 187 (noting that humans have cleared half of the forests on Earth over the last 8000 years); Carol Yoon, *Rain Forests Seen as Shaped by Human Hand*, N.Y. TIMES, July 27, 1993, at C1.

43. *See* UNITED NATIONS FOOD AND AGRICULTURE ORG. (FAO), THE STATE OF WORLD FISHERIES AND AQUACULTURE (1995); WORLD RESOURCES INST., *supra* note 42, at 195-96; Suzanne Iudicello & Margaret Lytle, *Marine Biodiversity and International Law*, 8 TUL. ENVTL. L.J. 123 (1994); Lawrence Ingrassia, *Dead in the Water: Overfishing Threatens To Wipe Out Species and Crush Industry*, WALL ST. J., July 16, 1991, at A1; Anne Swardson, *Net Losses: Fishing Decimating Oceans' "Unlimited Bounty,"* WASH. POST, Aug. 14, 1994, at A1.

per ton of fish caught, and progressive "fishing down" of the trophic level of marine species.[44] One consequence of these forest and fishery losses, as well as of other stresses, is the loss of a great deal of the Earth's biological diversity. The modern rate of species extinction, though difficult to measure, appears to be significantly faster than the rate of extinctions during prehuman geological history.[45] Biodiversity conservation is the goal of such treaties as the Convention on International Trade in Endangered Species of Fauna and Flora (CITES)[46] and the Convention on Biological Diversity,[47] and global fisheries are addressed by the United Nations Convention on the Law of the Sea (UNCLOS),[48] the International Whaling Convention,[49] and the Straddling Stocks Agreement.[50]

These global environmental problems share at least three common elements that distinguish them from national and local environmental problems: global impacts, global sources, and diversity of costs and benefits across countries. These three elements powerfully shape the choice of the optimal regulatory instrument for global environmental regulation.

A. *Global Impacts*

A primary challenge of global environmental problems is that they have global impacts, making abatement by any party beneficial to many and thus encouraging free riding. Consider a spectrum from local to global.[51] Local environmental problems involve impacts confined closely to the environs of

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44. *See* Daniel Pauly et al., *Fishing Down Marine Food Webs*, 279 SCIENCE 860 (1998); Christopher D. Stone, *Too Many Fishing Boats, Too Few Fish: Can Trade Laws Trim Subsidies and Restore the Balance in Global Fisheries?*, 24 ECOLOGY L.Q. 505 (1997); Nigel Williams, *Overfishing Disrupts Entire Ecosystems*, 279 SCIENCE 809 (1998).

45. Two-thirds of the 400 biologists polled in a recent survey by the American Museum of Natural History agreed that a "mass extinction" is currently underway and that up to 20% of all living species could disappear within three decades. *See* Joby Warrick, *Mass Extinction Underway, Majority of Biologists Say*, WASH. POST, Apr. 21, 1998, at A4. The survey ranked biodiversity loss as a more serious problem than global warming and ozone layer depletion. *See id.* The recently completed Global Biodiversity Assessment found that "the current rate of extinction among vertebrates and plants [is] 50 to 100 times the expected rate." Reid, *supra* note 42, at 19.

46. Mar. 3, 1973, 27 U.S.T. 1087, 993 U.N.T.S. 243 (entered into force July 1, 1975).

47. June 5, 1992, 31 I.L.M. 818 (entered into force Dec. 29, 1993).

48. Dec. 10, 1982, 21 I.L.M. 1261 (entered into force Nov. 16, 1994) [hereinafter UNCLOS].

49. International Convention for the Regulation of Whaling, Dec. 2, 1946, T.I.A.S. No. 4228, 161 U.N.T.S. 72 (entered into force Nov. 10, 1948) (as amended by 10 U.S.T. 952, 338 U.N.T.S. 366).

50. Agreement for the Implementation of Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, Aug. 14, 1995, 34 I.L.M. 1542 (not yet entered into force) [hereinafter Agreement on Straddling Fish Stocks].

51. *See* CHRISTOPHER D. STONE, THE GNAT IS OLDER THAN MAN: GLOBAL ENVIRONMENT AND HUMAN AGENDA 50-95 (1993) (distinguishing global externalities from transboundary externalities); Thomas W. Merrill, *Golden Rules for Transboundary Pollution*, 46 DUKE L.J. 931, 968-71 (1997) (distinguishing local, transboundary, and global environmental problems).

the source activity.[52] Transboundary environmental problems involve adjacent or closely located jurisdictions where activities in one jurisdiction (the source) cause impacts in a neighboring (victim) jurisdiction. Global environmental problems involve the entire planet: Activities that affect a common global resource thereby cause global impacts.

In a purely global problem, the locale of the source suffers no local impacts from the initial activity itself, but it feels the impact of its activities only as a fractional share of the overall global change to which it has contributed. The causal pathway is through the globally shared environmental medium, not through the direct effects of the source's pollution on nearby individuals or the neighboring jurisdiction. For example, a source of CO_2 emissions and its neighboring jurisdictions suffer essentially zero local impacts from the CO_2 emissions. The effects of the CO_2 emissions are felt only as a share of the global change in climate that the CO_2 causes some years later, once it has mixed into the global atmosphere.[53] The emissions source could be located anywhere on the planet and have the same global impact. The same applies to emissions of substances that deplete the stratospheric ozone layer: CFCs essentially have no local impacts, and the location of their emission is independent of their global impact, because they only affect global patterns of ultraviolet irradiation once they have risen over time to the stratosphere.

Thus, GHG emissions, CFC emissions, and biodiversity losses create global environmental externalities.[54] Prevention of these global externalities is a kind of "global public good." Global environmental quality benefits are nonexclusive. If a thick stratospheric ozone layer or a comfortable climate is provided, no one on the planet can be excluded from its effects; once the ozone layer thins or the climate changes, everyone is affected to

52. Of course, seemingly local activities can sometimes have far-reaching impacts on interconnected ecosystems. John Muir remarked a century ago that "[w]hen we try to pick out anything by itself, we find it hitched to everything else in the universe." Diary Entry (July 26, 1869), *in* JOHN MUIR, MY FIRST SUMMER IN THE SIERRA 157 (1911). The modern science of complexity theory has formalized the notion that small changes anywhere on the planet can have important global consequences. *See, e.g.*, DANIEL B. BOTKIN, DISCORDANT HARMONIES 7-8, 149-51, 155, 158-59 (1990); *cf.* MICHAEL S. GREVE, THE DEMISE OF ENVIRONMENTALISM IN AMERICAN LAW 3-7, 110-15 (1996) (criticizing the complexity premise on the ground that it renders impossible the legal control of environmental problems by any one political system).

53. Other pollutants emitted by the same activities that emit CO_2—e.g., particulate matter emitted by coal combustion—might well have important local impacts.

54. Although biodiversity is physically located in specific places, its loss can impose globally shared damages. *See* Ralph C. d'Arge & Allen V. Kneese, *State Liability for International Environmental Degradation: An Economic Perspective*, 20 NAT. RESOURCES J. 427, 433-34 (1980) (noting that the destruction of one country's biological features that harms residents of other countries is an externality of the same kind as pollution that spills over into other countries); Richard L. Revesz, *Federalism and Environmental Regulation: Lessons for the European Union and the International Community*, 83 VA. L. REV. 1331, 1344 (1997) ("[T]here is no analytical reason for treating existence values, also known sometimes as non-use values, differently from physical spillovers.").

some degree.[55] The public good characteristic applies both spatially and temporally: Abatement at one location generates protection benefits worldwide, and abatement today generates protection benefits for future generations.[56]

As a result, the individual is likely to receive only a tiny fraction of the global benefits of her abatement efforts because virtually all of the benefits accrue to others on the planet and to future generations.[57] To the extent that abatement is costly, it is likely that private individuals and individual countries will invest in substantially less abatement than would be desirable from a global collective point of view. Each individual and each country may think it better to avoid the costs of abatement while enjoying the shared benefit of others' efforts—"free riding" on others' abatement. Even though there may be net gains to collective action, each fears that others may free ride rather than cooperate, and the dominant strategy for each can be noncooperation.[58] The result is an undersupply of abatement effort

55. *See* JOSEPH E. STIGLITZ, THE THEORY OF INTERNATIONAL PUBLIC GOODS AND THE ARCHITECTURE OF INTERNATIONAL ORGANIZATIONS 1, 7 (Third Meeting of the United Nations High Level Group on Dev. Strategy and Mgmt. of the Mkt. Econ. Background Paper No. 7, 1995) (on file with *The Yale Law Journal*) (describing global environmental protection as a nonexcludable global public good); WORLD BANK, WORLD DEVELOPMENT REPORT 1997: THE STATE IN A CHANGING WORLD 131-37 (1997) (same). The protection of global biodiversity may be less of a pure public good because some of its fruits, such as genetic resources for medical applications, can be appropriated and privatized. But the global ecological functioning sustained by biodiversity and the carbon sequestration service provided by forests and marine phytoplankton are nonexclusive global public goods. *See* Christopher D. Stone, *What To Do About Biodiversity: Property Rights, Public Goods, and the Earth's Biological Riches*, 68 S. CAL. L. REV. 577, 580-88 (1995).

56. *See* TODD SANDLER, GLOBAL CHALLENGES 43, 67-69 (1997). Put another way, global environmental problems involve a global "riskshed." When airsheds or watersheds encompass multiple jurisdictions, management by individual jurisdictions may yield interjurisdictional spillovers and inefficiently little investment in protection of the shared public good. *See* Richard L. Revesz, *Federalism and Interstate Environmental Externalities*, 144 U. PA. L. REV. 2341 (1996). For efficient environmental management, the polity or cooperating group of polities should be coextensive with the riskshed, so that the full benefits of abatement are internalized. *See* JAMES M. BUCHANAN & GORDON TULLOCK, THE CALCULUS OF CONSENT 113 (1962) (noting that optimal jurisdiction size should expand until the added costs of decisionmaking exceed the added benefits of internalizing extrajurisdictional spillover effects); Herbert Hovenkamp & John A. Mackerron III, *Municipal Regulation and Federal Antitrust Policy*, 32 UCLA L. REV. 719, 720 (1985) ("As a general principle, efficient economic regulation requires a sovereign whose territory is large enough to encompass the entire regulated market . . . ."). With jurisdictions smaller than the riskshed, and in the absence of coordination among them, each jurisdiction has incentives to externalize costs to others and to free ride on others' abatement.

57. In terms of Garrett Hardin's famous example, in a world of five billion human residents, the average person who abates one unit of CFCs or GHGs pays the cost of doing so but reaps (roughly speaking) only one five-billionth of the current benefits, a smaller fraction of the benefits spread over present and future time periods, and an even smaller fraction if the benefits to non-human life are counted. *See generally* Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

58. *See* ROBERT AXELROD, THE EVOLUTION OF COOPERATION 7-9 (1984). Measures to increase confidence that others will cooperate, such as repeating the game into the foreseeable future, disaggregating the choice into continuous degrees of cooperation, and linking cooperation to reciprocity on other issues, can yield higher rates of cooperation. *See* Scott Barrett, *Building*

compared to the collective optimum.[59] Without some collective constraint on use of the resource, it will be overused from a global point of view—overharvested or overloaded with pollutants.[60] A central challenge for global regulatory design is to choose instruments that help overcome free riding and thereby facilitate efficient collective action.

B. *Global Sources*

A second challenge of global environmental problems is that they arise from sources that are globally widespread and mobile. Subglobal regulatory coverage will omit important sources. Moreover, subglobal regulatory coverage will encourage source activities to shift or "leak" to unregulated areas over time. Regulatory instruments thus face the challenge of effectively covering both present and future sources of global externalities.

This challenge is well illustrated in the climate change context. The sources of GHG emissions are everywhere. In every country, virtually every human activity directly or indirectly emits GHGs: fossil fuel combustion, biomass combustion, leaks from natural gas pipelines and coal mines, the clearing of forests and grasslands, wet rice farming, the raising of ruminant animals such as cattle and sheep, the use of nitrogen fertilizers to grow crops, and the disposal of wastes in landfills.[61] Although GHG-emitting activities may currently be more plentiful in the United States and other industrialized countries,[62] the geographic pattern of emitting activities is shifting over time. Even assuming no regulation of emissions in industrialized countries, during the next three decades, the majority of GHG emissions are expected to emanate from developing countries, where emissions are currently growing much faster than in wealthier countries.[63]

Property Rights for Transboundary Resources, *in* RIGHTS TO NATURE 265, 275-82 (Susan S. Hanna et al. eds., 1996).

59. *See* STIGLITZ, *supra* note 55, at 7; Hardin, *supra* note 57, at 1244-45; Stone, *supra* note 55, at 595 ("[T]he supply . . . of biologically rich areas is doomed to be suboptimal . . . absent a concerted effort by the world community to make conservation an attractive option to those with jurisdiction over the resource.").

60. "World peace, a sustainable global environment, a single world marketplace for goods and services, and basic knowledge are all examples of international public goods. They will be underprovided without conscious, concerted, and collective efforts to provide them." WORLD BANK, *supra* note 55, at 131. One study finds that countries acting on their own would engage in only 4% of the GHG abatement that they would find worthwhile to undertake under a global cooperative regime. *See* William D. Nordhaus & Zili Yang, *A Regional Dynamic General-Equilibrium Model of Alternative Climate-Change Strategies*, 86 AM. ECON. REV. 741, 762 (1996).

61. *See* Stewart & Wiener, *Global Climate Policy*, *supra* note 11, at 112.

62. *See* COUNCIL OF ECON. ADVISERS, ECONOMIC REPORT OF THE PRESIDENT 170-72 (1998).

63. *See id.* (stating that developing country emissions of CO_2 will exceed industrialized country emissions by the year 2030); C.J. Jepma, *A Generic Assessment of Response Options*, *in*

Constraints imposed on industrialized countries alone could induce "leakage" that further accelerates this shift of GHG-emitting activities to developing countries.

The same is true of CFCs.[64] Even though the Montreal Protocol is widely hailed as the most effective international environmental treaty ever adopted,[65] its effectiveness is being undercut by the rising production and use of CFCs and other ozone-depleting substances in less-regulated or unregulated countries and the attendant smuggling of such CFCs back into regulated countries.[66] Similarly, although forests and fisheries are not themselves easily mobile, harvesting activities are. Constraints imposed on harvesting in one country can be offset by increased harvesting by another country.[67]

In short, leakage is a serious problem for any subglobal constraint on the sources of global environmental externalities. It is worth noting that leakage does not depend only on plant closings and capital flight. There are three main pathways to leakage: a price effect, a "slack off" effect, and a capital relocation effect. First, the price effect operates in the short term, without any relocation of industry. Consider a treaty among a few countries that limits GHG emissions. Emissions abatement in country *T* (subject to

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IPCC ECON. 1995, *supra* note 6, at 223, 254-56 (suggesting that developing country emissions may exceed industrialized country emissions by 2020).

64. When the Montreal Protocol was adopted in 1987, three-quarters of all global CFC production was concentrated in roughly 12 countries. *See* SANDLER, *supra* note 56, at 111-12. The fear of leakage arising from unilateral U.S. regulations helped move U.S. industry in 1986 to favor multilateral regulation by all industrialized countries. *See supra* notes 29-34 and accompanying text (discussing the history of the regulation of CFCs). The fear of leakage to developing countries in response to the Montreal Protocol made it a high priority for the industrialized country parties to secure the participation of China, Russia, and India. *See* TONY BRENTON, THE GREENING OF MACHIAVELLI 142 (1994).

65. *See* Merrill, *supra* note 51, at 979 n.215.

66. *See* SANDLER, *supra* note 56, at 114-15 (describing the remaining challenges nations face in protecting the ozone layer after the Montreal Protocol, including the "greatest challenge": "policing the illegal trade in CFCs" by the Russian Federation and developing countries not subject to the stringent CFC phaseout that governs industrialized countries); WORLD RESOURCES INST., *supra* note 42, at 178 (describing illegal trade in CFCs by developed nations and the "unexpectedly rapid rise in the use of CFCs and other ozone depleting chemicals in some developing nations" (citations omitted)).

67. For example, if logging in the Pacific Northwest region of the United States is restricted, world timber markets may shift to increase logging in Canada, Russia, or other countries. *See* ROGER A. SEDJO ET AL., GLOBAL FOREST PRODUCTS TRADE: THE CONSEQUENCES OF DOMESTIC FOREST LAND-USE POLICY (Resources for the Future Discussion Paper No. 94-13, 1994); Con H. Schallau & Alberto Goetzl, *Effects of Constraining US Timber Supplies*, 90 J. FORESTRY 22, 25 (1992); Roger A. Sedjo, Environmental Impacts of Forest Protection: Some Complications 3-5 (Mar. 18, 1996) (unpublished manuscript, on file with *The Yale Law Journal*). The harvesting of fisheries is even more mobile. Any country can be the flag state for fishing fleets operating on the open-access high seas. Thus, restrictions on high seas fishing by countries currently involved in the industry can be offset by increased fishing under the flag of unconstrained countries. For example, when the member states of the Northwest Atlantic Fishing Organization reduced their allowable catch on the high seas by 8.7% from 1986 to 1992, non-member states increased their take in this region by 27.7%. *See* LAKSHMAN D. GURUSWAMY & BRENT R. HENDRICKS, INTERNATIONAL ENVIRONMENTAL LAW IN A NUTSHELL 284 (1997).

the treaty) would reduce the demand for fossil fuels in country *T*, lowering the world market price for such fuels and thereby increasing the quantity demanded in country *Z* (a country not party to the treaty). Similarly, a treaty restricting forest clearing in country *T* would raise the world price for timber, inducing an increase in the quantity of timber cut in country *Z*. The price-driven leakage effect depends on the price elasticities of the relevant economic activity in the regulated and unregulated areas.

Second, the "slack off" effect is a response to changing national net benefits. In the absence of a treaty, country *Z* might undertake some abatement, just up to the point where its (small) domestic share of the global marginal benefits would equal its domestic marginal costs of abatement. But once country *T* and the other treaty parties begin to abate their own emissions more aggressively, some global protection would be obtained, and the marginal benefits to country *Z* of its own abatement efforts would be diminished slightly, so that its domestically rational degree of abatement would also fall. Hence as treaty parties emit less, non-parties would rationally emit more.[68] This effect is independent of the previously described price effect.[69]

Third, in the longer term, restrictions on emissions in one country could induce emissions-intensive industries to relocate to unregulated countries, in order to produce their products at lower cost and export their products to wherever their consumers happen to be (perhaps in the regulated country, but perhaps elsewhere). The extent of this relocation effect depends on the marginal cost of the emissions constraint relative to the marginal cost of relocating. Relocation may seem more likely for durable goods such as fertilizers and timber than for energy services such as electricity; still, even electricity is increasingly being transmitted long distances across national borders from generator to user.

Cumulative leakage depends on the fluidity of these three pathways and on a fourth variable: the relative environmental damage caused by the activity in the constrained and unconstrained countries. Assume, for example, that reducing fuel use in country *T* by two units induces an increase in fuel use in country *Z* of one unit (a leakage rate of fifty percent). But if that one unit of fuel use in country *Z* is associated with twice as much (or twice as potent) total GHG emissions as the two units of fuel use in *T* (e.g., because *Z* lets the fuel's highly potent methane (CH_4) component

68. *See* Scott Barrett, *The Strategy of Joint Implementation in the Framework Convention on Climate Change*, at 15-16 & n.7, U.N. Doc. UNCTAD/GID/10 (1995); Stavins, *supra* note 13, at 17 n.42; Richard B. Stewart, *Environmental Regulation and International Competitiveness*, 102 YALE L.J. 2039, 2055 n.74 (1993).

69. There might also be an opposing "technology scale" effect, in which abatement by country *T* and its treaty colleagues stimulates economies of scale in abatement technologies, which reduces the marginal cost of abatement in country *Z* and thereby raises the domestically rational degree of abatement in *Z*.

escape to the atmosphere rather than fully combusting it into less-potent CO_2 as is done in country *T*), then the total climatic effect of the leakage could exceed 100%. Or if reducing timber harvesting in country *T* by two units induces an increase in timber harvesting in country *Z* by one unit, but the damage to biodiversity from logging in *Z* is twice that in *T* (e.g., because loggers in *Z* employ especially disruptive methods, or because the biodiversity value of forests in *Z* is higher than that of the forests in *T*), then the total biodiversity impact of the leakage would be 100%.

Depending on these four factors, leakage could be large or small. For GHG emissions control, several studies have produced a wide range of estimates, finding that under emissions limits imposed in the EU or the OECD, leakage would offset from 4% to more than 100% of the emissions abatement achieved initially.[70]

Leakage has several undesirable consequences. First, leakage at least partly offsets the environmental effectiveness of the treaty. A subglobal regulatory regime could be only modestly helpful in protecting the global environment. If the three leakage pathways weighted by the relative environmental damage factors exceed 100%, a subglobal regime would actually make things worse. At the least, the cost-effectiveness of the regulatory regime must be assessed in terms of its net effect on global emissions or resource use, not just in terms of its effect on activities within the cooperating countries.

Second, even if ex post leakage is actually unlikely, fear of leakage may be a political obstacle to subglobal action. Of special concern to national legislators is the fact that leakage may imply the relocation of employment opportunities away from regulated voting districts. The Byrd-Hagel Resolution,[71] passed ninety-five to zero in July 1997, announced the U.S. Senate's insistence on participation by developing countries in any future climate treaty, on the ground that U.S. action to restrict GHG emissions could impair the U.S. economy while driving GHG-intensive

70. *Cf.* B.S. Fisher et al., *An Economic Assessment of Policy Instruments for Combatting Climate Change*, *in* IPCC ECON. 1995, *supra* note 6, at 424-25 (reviewing numerous studies); J.C. Hourcade et al., *A Review of Mitigation Cost Studies*, *in* IPCC ECON. 1995, *supra* note 6, at 297, 341-43 (same). The studies of GHG leakage differ in the economic sectors they model and in their representations of international trade flows. Not all the models consider all three pathways for leakage. Most models omit the possibility of higher overall GHG emissions per unit of resource use in the unregulated countries. For good examples of efforts to sharpen models of leakage, see NICK MABEY ET AL., ARGUMENT IN THE GREENHOUSE: THE INTERNATIONAL ECONOMICS OF CONTROLLING GLOBAL WARMING 26, 28, 266-302, 397-400 (1997); Stefan Felder & Thomas F. Rutherford, *Unilateral CO_2 Reductions and Carbon Leakage: The Consequences of International Trade in Oil and Basic Materials*, 25 J. ENVTL. ECON. & MGMT. 162 (1993); and John Pezzey, *Analysis of Unilateral CO_2 Control in the European Community and OECD*, 13 ENERGY J. 159, 166 (1992).

71. 143 CONG. REC. S8113-05 (daily ed. July 25, 1997).

activities and jobs abroad.[72] The day after the Kyoto Protocol was signed, the Clinton Administration announced that it would not submit the treaty to the Senate for ratification until developing countries had agreed to accept emissions limitation responsibilities as well.[73] Hence, even if subglobal action would not cause actual leakage, the fear of leakage could impede globally desirable action.[74]

Third, leakage could also adversely influence the incentives of initial nonparticipants to join the regulatory treaty subsequently. As leakage proceeds, it shifts the regulated activity to the unregulated areas and thereby renders the unregulated economies even more emissions-intensive (or resource-intensive) than they had been before the treaty. This makes it ever harder to persuade the initial nonparticipants to join the treaty later.[75]

In sum, because the sources of global environmental externalities are widespread and mobile, subglobal regulation can omit important sources today and induce leakage of sources to unregulated areas tomorrow. Subglobal coverage can thus undermine or even reverse the environmental benefits of the regulation, discourage initial action, and discourage future accession by initial nonparticipants. Effective global environmental regulation will therefore require universal or nearly universal coverage of

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72. *See Climate Change: Senate Approves Resolution To Require Binding Controls on Developing Nations*, 28 Env't. Rep. (BNA) at 621 (Aug. 1, 1997). "[T]he giant developing countries like India and China have yet to be brought on board. Until that happens, Senate ratification is out of the question." *Remember Global Warming?*, Editorial, N.Y. TIMES, Nov. 11, 1998, at A26. Similar fears prompted enlargement of the Montreal Protocol to include large developing countries. *See supra* note 64.

73. *See* John M. Broder, *Clinton Adamant on Third World Role in Climate Accord*, N.Y. TIMES, Dec. 12, 1997, at A1.

74. Even if regulatory competition among jurisdictions to attract industry and voters would produce optimal internal environmental quality standards within each jurisdiction (a hotly debated proposition), it would not produce optimal global environmental regulation of interjurisdictional spillovers. Models of efficient regulatory competition assume that all environmental quality effects are internal to each jurisdiction. *See* Kirsten H. Engel, *State Environmental Standard-Setting: Is There a "Race" and Is It "to the Bottom"?*, 48 HASTINGS L.J. 271, 307 (1997) (noting that in a particular model of efficient interjurisdictional regulatory competition, all environmental impacts are assumed to remain confined within each jurisdiction); Merrill, *supra* note 51, at 968-70 (distinguishing regulatory competition from transboundary pollution). When internal policies affect the environment of other jurisdictions, the case for coordinated regulation is strong. *See* Revesz, *supra* note 56 (criticizing the "race to the bottom" hypothesis as a rationale for overarching regulation but endorsing the interstate externality hypothesis as a sound basis for overarching regulation). Even if industry flight to jurisdictions with less stringent environmental regulation is unlikely today, *see* Stewart, *supra* note 68, at 2077-79, the fear of such flight could inhibit action by countries to protect the global environment, *see* Merrill, *supra* note 51, at 969 n.186 ("[T]he *perception* of a possible race-to-the-bottom is widely shared by both environmentalists and local politicians, and this . . . translates into a demand for centralization of environmental controls."), and the costs of new regulations to protect the global environment could be sufficiently large to spur industry flight.

75. *See* Richard Schmalensee, *Greenhouse Policy Architectures and Institutions*, *in* ECONOMICS AND POLICY ISSUES IN CLIMATE CHANGE 137, 146 (William D. Nordhaus ed., 1998).

present and potential source locations.[76] A central challenge for global regulatory design is to choose instruments that maximize the coverage of sources and prevent leakage.

C. *Local Diversity*

A third basic challenge is that even though the impacts and sources are global, they vary widely around the world. Local diversity is manifest in at least three dimensions: costs of abatement, benefits of abatement, and social and legal systems.

1. *Costs of Abatement*

First, although the sources of global environmental degradation are globally dispersed and mobile, the cost of controlling these sources is not uniform and varies considerably. The costs of abatement vary because differences in technology, available substitutes, and economic structure, among other factors, make avoiding future emissions or resource use much less costly in some places than in others. For example, one study found a fifty-fold difference in GHG abatement costs just within the membership of the European Union.[77] Variation in abatement costs across the entire world, including developing countries, Eastern European countries, the former Soviet Union, and industrialized countries, is likely to be much greater.

This variation in abatement costs implies that the least-cost global protection strategy involves employing the most cost-effective options first, wherever they may be located around the world. As with other goods and services, there are local comparative advantages in supplying global environmental protection services such as emissions abatement and biodiversity conservation. Requiring every country to achieve a uniform degree of emissions abatement would miss the opportunity to supply the same overall global protection at lower cost. There will be mutual gains from trade if the beneficiaries of such services can purchase them from the most cost-effective suppliers worldwide. A key challenge for global environmental regulation is to choose instruments that reduce global costs by harnessing the most cost-effective pattern of abatement.

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76. *See* MABEY ET AL., *supra* note 70, at 28 ("As long as international obligations to reduce CO_2 emissions are limited to a few countries the problems of carbon leakage through energy market responses and industrial relocation will remain an obstacle to successful environmental protection. The evolution of the FCCC into a globally inclusive treaty is therefore imperative . . . ."); Henry D. Jacoby et al., *Kyoto's Unfinished Business*, FOREIGN AFF., July-Aug. 1998, at 54, 60 ("[A] substantial reduction in global emissions will require something close to worldwide participation . . . .").

77. *See* Scott Barrett, *Reaching a CO_2-Emission Limitation Agreement for the Community: Implications for Equity and Cost-Effectiveness*, 1 EUR. ECON. 3, 16 (1992).

2. *Benefits of Abatement*

Second, although the impacts of global environmental change are spread globally and are nonexcludable once instigated, the benefits of preventing global environmental change are not uniform and may be large in some places but small or even negative in others. To begin with, countries vary in the physical damage that a given increment of global environmental change would induce. For example, some countries may be particularly vulnerable to global warming; sea-level rise and storm surges may be most worrisome for coastal areas and small island states,[78] and countries dependent on fragile food supplies may be more vulnerable to changes in precipitation.[79] By contrast, other countries, especially wealthier countries, may be more resilient to global warming or better able to adapt at low social cost.[80] And some countries might even benefit—or at least perceive, correctly or not, that they would benefit—from some global warming. For example, colder countries where growing seasons could expand might benefit in a warmer world, or at least they might think they would benefit. China and Russia, two of the largest sources of GHG emissions, could fall into this category.[81]

In addition, countries vary in how they value a given amount of physical damage due to global environmental change. For example, wealthier populations might be more inclined to invest scarce social resources in UV, climate, and biodiversity protection than might poorer populations struggling to address other priorities for survival and prosperity such as education, infant mortality, clean drinking water, and sanitation. The priority put on environmental protection is usually thought to rise with

78. *See* T. Banuri et al., *Equity and Social Considerations*, *in* IPCC ECON. 1995, *supra* note 6, at 79, 96-97.

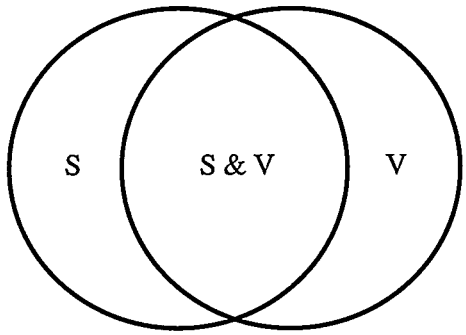
79. *See id.*

80. *See id.* at 92.

81. *See* Michael Hoel, *How Should International Greenhouse Gas Agreements Be Designed?*, *in* THE ECONOMICS OF TRANSNATIONAL COMMONS 172, 181 (Partha Dasgupta et al. eds., 1997) ("[O]ne could argue . . . that significant parts of the former USSR would benefit from a warmer climate."); A.L. Hollick & R.N. Cooper, *Global Commons: Can They Be Managed?*, *in* THE ECONOMICS OF TRANSNATIONAL COMMONS, *supra*, at 141, 168 ("[S]ome countries may be expected to benefit from at least a modest amount of warming (e.g., . . . the [former] Soviet Union), and this possibility may also induce reluctance to contribute to an international [abatement] effort."); Oran R. Young, *The Politics of International Regime Formation: Managing Natural Resources and the Environment*, 43 INT'L ORG. 349, 367-68 (1989) (suggesting that some areas may benefit from a warmer planet); Zhou Xin, *The Benefits of Climate Change? China's Take on Global Warming* (Feb. 9, 1997) <http://www.weathervane.rff.org/features/feature012.html> (reporting that Chinese researchers have concluded that a warmer climate will benefit China and other developing countries). Aronson argues that China and the United States may be cooperative losers from global climate protection because their costs of abatement (absent financial assistance from other countries) would exceed their gains from abatement. *See* Aronson, *supra* note 11, at 2151-56; *cf.* MABEY ET AL., *supra* note 70, at 354-55, 368-69 (suggesting that cooperation may be unprofitable for the United States); SANDLER, *supra* note 56, at 106 (same).

income.[82] In addition, poorer populations may have higher discount rates for future benefits. Thus, even if poorer populations would be more vulnerable to physical climate change damages than wealthier countries, they might also have other nearer-term priorities for public policy attention, especially if global environmental change is a long-term risk and these countries confront immediate threats of illness, famine, and social unrest. Developing countries may view climate change as a problem that should be solved by industrialized countries; developing countries may have little appetite for making sacrifices to limit global GHG emissions.[83] Moreover, for countries like China and Russia, who appear to perceive themselves as beneficiaries of global warming,[84] GHG emissions abatement may have very low or even negative value.

FIGURE 1. SOURCES AND VICTIMS OF GLOBAL EXTERNALITIES



S = Sources of Global Externality
V = Victims of Global Externality (Beneficiaries of Regulation)

82. *See, e.g.*, SANDLER, *supra* note 56, at 71 (noting that at the global level, interest in environmental quality rises with national income); William J. Baumol, *Environmental Protection and Income Distribution*, *in* REDISTRIBUTION THROUGH PUBLIC CHOICE 93, 93 (Harold M. Hochman & George E. Peterson eds., 1974) (noting that the demand for environmental protection increases with income).

83. *See* JOYEETA GUPTA, THE CLIMATE CHANGE CONVENTION AND DEVELOPING COUNTRIES: FROM CONFLICT TO CONSENSUS? at viii (1997); Cheng Zheng-Kang, *Equity, Special Considerations, and the Third World*, 1 COLO. J. INT'L ENVTL. L. & POL'Y 57, 59-62 (1990). Based on a study of four important developing countries—India, Indonesia, Kenya, and Brazil—Dr. Gupta finds that "although the potential climate change impacts may be serious, the problem is not perceived as a priority by domestic actors . . . ." GUPTA, *supra*, at viii. Gupta adds that developing countries in general "are afraid that . . . the FCCC might end up being a vehicle to protect the rights of future [industrialized country] generations at the cost of current [developing country] generations." *Id.* at x; *see also* ROBERT W. HAHN, THE ECONOMICS & POLITICS OF CLIMATE CHANGE 5 (1998) ("[M]ost developing countries do not believe that the climate-change issue is a high priority for them and . . . they fear that emission controls could slow their economic development.").

84. *See supra* note 81 and accompanying text.

Because both costs and benefits vary across locales, the net benefits of global environmental regulation will vary. Figure 1 crudely illustrates this diversity. As one moves from left to right across Figure 1, the net benefits of global environmental regulation rise. At one extreme, countries that are sources (*S*) of global environmental externalities, but not victims, incur strictly negative net benefits—they are pure losers from global regulation. An example in the climate change context might be an oil-producing country with a society that is not highly vulnerable to climate change, or a major emitter like China if it perceives gains from allowing global warming to occur. At the other extreme, countries that are victims (*V*) of global environmental externalities, but not sources, incur strictly positive net benefits—they are pure beneficiaries of global regulation. An example in the climate change context might be the small island states. In the middle, countries that are both sources and victims (*S&V*) of global environmental externalities will bear both benefits and costs from global regulation.[85] Many in this intermediate group will perceive net gains from global regulation, but some will perceive net costs.

Thus, all in Group *V* and some in Group *S&V* will be net winners from global environmental regulation, while all in Group *S* and some in Group *S&V* will be net losers from global environmental regulation. The point is essentially that polluters may not find pollution control to be in their self-interest. The relative sizes of the winner and loser groups (and the degree of their gains and losses) depend, of course, on the environmental problem in question, the pattern of economic activity across countries, and, critically, the regulatory instrument chosen to address the global externality. A key challenge for global environmental regulation is to choose an instrument that maximizes global net benefits while achieving an acceptable distribution of net benefits across countries.

3. *Social and Legal Systems*

There is also great diversity in social and legal systems across countries. Even in an increasingly globalized economy, different countries have widely divergent histories, wealth, economic growth rates, cultures, systems of government, and laws.[86] Such diversity has important implications for global environmental regulation. Different countries may have different preferences for the optimal degree of environmental

85. *See* BAUMOL & OATES, *supra* note 3, at 279; Scott Barrett, *The Problem of Global Environmental Protection*, 6 OXFORD REV. ECON. POL'Y. 68, 70-72 (1990); Merrill, *supra* note 51, at 971.

86. *See generally* NATIONAL DIVERSITY AND GLOBAL CAPITALISM (Suzanne Berger & Ronald Dore eds., 1996) (considering the effect of national idiosyncrasies on the development of global capitalism).

protection and the optimal choice of regulatory instruments, based on their own national norms and conceptions of efficiency and fairness, and their own national experience (or lack of experience) with the regulatory instruments in question. Moreover, global regulatory instruments may be impeded by local diversity in implementation. This is true for all regulatory instruments, but potentially with different problems for different instruments. As discussed further in Part V, globally coordinated environmental taxes would have to be incorporated into countries' national tax systems, some of which could inhibit the effectiveness of the global tax. And international tradeable allowance systems would have to overcome the barriers and transaction costs of a global market segmented into diverse legal systems.

D. *Implications*

These three challenges of global environmental problems—global impacts, global sources, and local diversity—set the stage for regulatory choice. They imply that attracting participation—overcoming free riders, constraining leakage, and engaging non-beneficiary sources—will be crucial to any successful global environmental regulation.

III. CHOICE OF REGULATORY TOOLS UNDER UNITARY FIAT

This Part begins the analysis of global regulatory instrument choice by summarizing the standard analysis under "Unitary Fiat." This standard analysis sets the baseline for comparing the calculus of instrument choice when the legal system diverges from Unitary Fiat. This comparison is undertaken in Parts IV and V. The analysis reviewed in Part III, while familiar to many readers, also bears reexamination because its underlying rationales—in favor of incentives, against subsidies, and in favor of taxes—play crucial but novel roles in the analysis of global instrument choice in Parts IV and V.

A. *The Assumption of Unitary Fiat*

The debate over the normative design of environmental regulation has generally been conducted on the premise that the choice of instrument is made by a rational policy designer who selects the optimal instrument and coercively dictates its imposition on sources. This assumption is deeply ingrained in the analytic debate and is so natural to anyone steeped in the literature that it almost goes without saying—and often does.

The theory of regulatory instrument choice has a long tradition of assuming Unitary Fiat. Although many analysts take this point for granted,

some examples from classic works in the field serve to demonstrate the centrality of the assumption. Arthur Pigou's original argument for corrective taxes to internalize externalities expressly declared the need for "intervention" by "the State" when private costs and social costs diverge.[87] He endorsed Alfred Marshall's suggestion that citizens be "compelled to contribute" to the provision of public goods.[88] He asserted that in cases of externalities "the Government may find it necessary to exercise some means of authoritative control .... It is, therefore, necessary that an authority ... should intervene and should tackle the collective problems" of pollution.[89]

The contemporary debate reflects the same assumption. Guido Calabresi and A. Douglas Melamed describe property rules and liability rules as instruments for collective edicts as to the assignment and valuation of entitlements;[90] they note in particular that liability rules require "coercing compliance."[91] In his discussion of instrument choice, Stephen Breyer repeatedly refers to the decision being dictated by "an administrator."[92] Likewise, Louis Kaplow and Steven Shavell say that assigning property rules involves the "police powers" of "the state" and that liability rules amount to the state's "requiring" payments.[93] In a footnote, they state their assumption that the regulatory instrument is chosen and imposed on the parties by a court, expert agency, or other single rational decisionmaker.[94] Similarly, in their survey of instrument choice, Peter Bohm and Clifford Russell explicitly assume that a central government agency will adopt and enforce the regulation chosen.[95] In his Nobel Prize address, James Buchanan observed that economists tend to "proffer[] policy advice as if they were employed by a benevolent despot."[96]

The hypothetical construct of rational design by autocratic fiat—whether Buchanan's "benevolent despot,"[97] Blackstone's "sole and despotic" property owner,[98] or a rational benefit-maximizing administrative regulator—is the traditional device for imagining normatively optimal

87. PIGOU, *supra* note 3, at 192.
88. *Id.* at 193 (citation and internal quotation marks omitted).
89. *Id.* at 194-95.
90. *See* Calabresi & Melamed, *supra* note 5, at 1092, 1096-97, 1107.
91. *Id.* at 1120.
92. BREYER, *supra* note 2, at 266, 273.
93. Kaplow & Shavell, *supra* note 5, at 715.
94. *See id.* at 723 n.28.
95. *See* Bohm & Russell, *supra* note 5, at 397.
96. James M. Buchanan, *The Constitution of Economic Policy*, 77 AM. ECON. REV. 243, 243 (1987).
97. *Id.*
98. 2 WILLIAM BLACKSTONE, COMMENTARIES *2.

policy choice.[99] The efficiency criterion for such rational fiat is the Kaldor-Hicks test: Aggregate benefits must exceed aggregate costs (so that winners gain enough to be able to compensate losers, although such compensation need not actually occur).[100] Kaldor-Hicks efficiency is the basis on which economists conventionally discuss instrument choice.[101] This perspective enables benevolent fiat to be insulated from the messiness of distributional politics. As Fischel and Shapiro put it, the

> Pigovian model of government . . . assumes that government is an unimpeachable benefit-cost machine. It does not inquire about the distribution of benefits, nor can it be manipulated by any faction of those governed. . . . [G]overnment decisions do not depend on the will of *anyone*, let alone the majority. . . . The Pigovian model . . . is adopted in most public policy models as an innocent ceteris paribus assumption . . . .[102]

To depict Unitary Fiat at the global level, one must imagine a hypothetical global regulator. She is a "benefit-cost machine" who selects the optimal global regulatory instrument for worldwide application. There is no problem of "leakage" from subglobal application, because the hypothetical Unitary Fiat regulator can dictate global regulation. There is no need to secure nation-states' consent, just as consent by polluters would be irrelevant to optimal instrument choice under Unitary Fiat at the national level. The global regulator would aim to maximize global well-being and would consider the varying interests of different societies in global environmental regulation, described in Part II, as they cumulate in the global aggregate benefit-cost test. Given a level of global environmental protection to achieve, she would choose the most efficient instrument for achieving that degree of protection—that is, the instrument that achieves the given level of protection most cost-effectively.[103] She might also care

99. *See* John K. Setear, *Responses to Breach of a Treaty and Rationalist International Relations Theory: The Rules of Release and Remediation in the Law of Treaties and the Law of State Responsibility*, 83 VA. L. REV. 1, 5 (1997) (describing the use of "rational design" by a single actor as a common thought experiment for imagining optimal decisionmaking).

100. *See* BAUMOL & OATES, *supra* note 3, at 96 n.4; RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 13-15 (4th ed. 1992).

101. *See* POSNER, *supra* note 100, at 14.

102. William A. Fischel & Perry Shapiro, *Takings, Insurance, and Michelman: Comments on Economic Interpretations of "Just Compensation" Law*, 17 J. LEGAL STUD. 269, 285 (1988).

103. Choosing "how to" regulate can be distinguished from deciding "how much" to regulate. *See* Bohm & Russell, *supra* note 5, at 397 ("[C]hoice of policy goal and choice of instrument or implementation system are essentially separable problems."). Given a target level of environmental protection—determined by cost-benefit analysis, by political compromise, by moral imperative, or by any other method—the regulator still faces the important choice of how to achieve that level. This is the choice among regulatory instruments. As a practical matter, regulators often must take the degree of policy stringency as given. They then can choose incentive-based regulatory instruments such as taxes or tradeable allowances for reasons of cost-effectiveness, even if the desired level of protection was not determined on economic efficiency

about fairness and morality (although, as discussed below, the standard economic analysis of instrument choice under Unitary Fiat has paid limited attention to these attributes).

B. *The Global Regulator's Toolbox*

The regulator seeking to constrain environmental externalities can choose instruments from a well-stocked toolbox. Most or all of these instruments employ one or a hybrid of three basic regulatory approaches:[104]

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criteria. *See* Howard K. Gruenspecht & Lester B. Lave, *The Economics of Health, Safety, and Environmental Regulation*, *in* 2 HANDBOOK OF INDUSTRIAL ORGANIZATION 1507, 1520-21 (Richard Schmalensee & Robert D. Willig eds., 1989) ("[R]egulatory targets are usually set through the political process, not through the use of some grand optimization calculus. [Economists can help] by taking the politically set objectives as given and devising a cost-minimizing approach to reaching them, thereby pursuing the goal of cost-effectiveness rather than optimality."); Richard Revesz, Book Review, 11 ECOLOGY L.Q. 451, 454 (1984) (arguing that incentive-based regulatory instruments "can minimize the cost of achieving a level of pollution control determined by nonmarket means [and could] be preferred by those who do not share the view that all social allocations should be guided solely by considerations of economic efficiency"). Conversely, regulators could choose conduct-based, command-and-control regulatory instruments for nonefficiency reasons, even if the desired level of protection was determined on efficiency criteria. Operational evidence for the independence of the criteria for choosing "how much" and "how to" is offered by the fact that some important U.S. pollution control laws employ incentive-based controls to achieve goals set on nonefficiency criteria, *see, e.g.*, Clean Air Act § 401, 42 U.S.C. § 7651 (1994) (using tradeable allowances to achieve a politically determined level of reduction in sulfur dioxide emissions), while other laws employ technology-based controls to achieve goals set on cost-benefit efficiency criteria, *see, e.g.*, Clean Water Act § 304, 33 U.S.C. § 1314(b)(1)(b) (1994) (using "best technology" standards to achieve reductions in water pollution set by consideration of costs in relation to benefits).

Choosing how to regulate may be irrelevant when the answer to the question of how much to control pollution is zero (i.e., no regulation), and it may also be irrelevant when the answer approaches infinity (i.e., a complete prohibition on the risky activity). But between these polar cases is a vast intermediate zone in which the "how to" choice of regulatory instrument matters a great deal.

104. For reviews of the available regulatory tools, see, for example, BAUMOL & OATES, *supra* note 3, at 155-234; ROBERT PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE AND POLICY 154-58 (2d ed. 1996); Bohm & Russell, *supra* note 5; Dudek et al., *supra* note 2, at 5-15; and Fisher et al., *supra* note 6, at 397, 403-05. Hanson and Logue also classify regulatory instruments into three basic types: "command-and-control rules" (i.e., conduct rules), "performance-based standards" that might "specify the maximum quantity of pollution that a firm may produce" (i.e., quantity rules, though Hanson and Logue omit the option of tradeable quantity allowances), and "incentive-based systems" (by which they mean price-based instruments, i.e., taxes and liability rules). Hanson & Logue, *supra* note 14, at 1173-74. I group taxes, liability rules, and tradeable allowances (but not fixed quantity standards) under the general heading "incentive-based," because they all attempt to "reconstitute" markets with appropriate incentive signals, as discussed in the text. I follow Weitzman and Calabresi and Melamed in emphasizing the distinction between price/liability rules and quantity/property rules. *See* Calabresi & Melamed, *supra* note 5; Weitzman, *supra* note 5. Of course, these classifications are not based on razor-sharp distinctions. *See* Hanson & Logue, *supra* note 14, at 1263 n.422. There are also hybrid tools, such as deposit-refund systems (a version of the price-based approach), allowance systems with ceiling or floor prices (a hybrid of quantity and price instruments), and rules requiring the disclosure of information to product consumers or local residents. What ultimately matters are the outcomes produced by the different instruments.

1. *Conduct instruments*: regulations specifying the sources' technology of production (command-and-control regulations, design standards, technology-based standards, traditional negligence rules);

2. *Price instruments*: regulations forcing sources to pay the social cost of the entitlement to generate external harm (liability rules, taxes, abatement subsidies); or

3. *Quantity instruments*: regulations allocating entitlements to generate or be free from external harm (property rules, performance standards, tradeable allowances).

Conduct-oriented, "command-and-control" regulation has been a conventional environmental regulatory approach. Courts traditionally have based determinations of negligence liability on whether a defendant had taken "due care," which was in turn defined as the use of certain minimally acceptable technologies or practices.[105] Legislatures or administrative agencies have frequently prescribed particular product designs, particular fishing methods, and particular pollution control technologies. The "best available technology" requirements under several U.S. environmental laws are a prime example.[106]

By contrast, "reconstitutive" or "incentive-based" regulation comes in two basic forms: price-based or quantity-based instruments.[107] Under price-based or "liability rule" regulation, government sets the price of an entitlement (to cause external harm) and lets private parties determine the quantity produced. Under quantity-based or "property rule" regulation, government assigns a quantity of entitlements (to cause or be free from external harm) and lets private parties bargain over the price.[108]

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105. The traditional negligence rule based liability on the failure to undertake due care, defined as particular technical methods or practices; this continues to be the rule for certain areas of law such as medical malpractice. *See* POSNER, *supra* note 100, at 168-69. The more modern negligence rule, most famously articulated by Judge Learned Hand in 1947, bases liability on the failure to invest in prevention up to the point where the marginal cost of precautions matched the probable marginal benefits of avoided injuries (in Hand's terminology, investing up to the point where the Burden of precautions equals the Probability multiplied by the Loss, or $B = PL$). *See* United States v. Carroll Towing, 159 F.2d 169, 173-74 (2d Cir. 1947).

106. *See* Dudek et al., *supra* note 2, at 8; *see also, e.g.*, Clean Air Act § 111(h), 42 U.S.C. § 7651 (1994) (authorizing the EPA Administrator to require a "design standard . . . which reflects the best technological system of emission reduction" for new sources); Clean Water Act § 301(b)(2)(A), 33 U.S.C. § 1314 (1994) (requiring "application of the best available technology economically achievable").

107. *See* Richard B. Stewart, *Reconstitutive Law*, 46 MD. L. REV. 86, 92 (1986).

108. *See* Calabresi & Melamed, *supra* note 5, at 1092; Weitzman, *supra* note 5, at 477-79; *cf.* POSNER, *supra* note 100, at 375-77 (comparing design standards to negligence liability, taxes to strict liability, and quantity standards to prohibitions backed by penal sanctions); Kaplow & Shavell, *supra* note 5, at 750 n.119, 751 (analogizing taxes to liability rules and tradeable allowances to property rules). Performance standards are a middle case: They set fixed quantity

1. *Conduct Instruments: Command-and-Control Technology Requirements*

A global regulator could employ conduct-based regulations to mandate worldwide practices and technologies to protect the global environment. She might, for example, require sources to adopt automobile fuel economy standards, similar to the "corporate average fuel economy" standards in force in the United States, or energy efficiency standards for appliances and industrial processes.[109] Or she might require installation of specific emissions control technology, such as CO_2-scrubbers on all new coal-fired electric power plants.[110] She might also require adherence to global standards for the practice of "sustainable forestry."[111] Or she might require fishing fleets to adopt certain technologies, such as turtle excluder devices for shrimp fishing,[112] or forbid certain technologies, such as setting tuna nets around dolphins or using driftnets.[113]

2. *Price Instruments: Liability Rules, Taxes, and Subsidies*

A global regulator could also achieve global environmental goals by using judicially or administratively imposed price instruments to force sources to internalize the global environmental costs of their activities. These price instruments could be imposed ex post or ex ante. An ex post price instrument would impose strict liability on sources of pollution for the damages actually caused to the global environment. Indeed, strict liability for external environmental harm is the regulatory instrument generally understood to be provided by customary international law.[114] This liability

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limits on emissions. Unlike conduct instruments, they allow sources the internal flexibility to choose compliance methods. But unlike taxes and tradeable allowances, they are less "incentive-based" or "reconstitutive" because they set fixed limits for each source and preclude flexibility across sources.

109. *See, e.g.*, *Bergen Ministerial Declaration on Sustainable Development in the ECE Region*, [1990] 1 Y.B. INT'L ENVTL. L. 429, U.N. Doc. A/CONF. 151/PC.10/Annex 1 (advocating coordinated adoption of more stringent automobile fuel economy standards); ENVIRONMENTAL WORKING GROUP, *supra* note 7.

110. *See, e.g.*, Edmonds & Wise, *supra* note 7, at 6.

111. *See, e.g.*, DAVID HUMPHREYS, FOREST POLITICS 21, 136-45 (1996).

112. *See, e.g.*, John H. Cushman, Jr., *Trade Group Strikes Blow at U.S. Environmental Law*, N.Y. TIMES, Apr. 7, 1998, at C1 (describing U.S. requirements for turtle excluder devices and World Trade Organization decision against such unilateral requirements).

113. *See, e.g.*, Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific, Nov. 24, 1989, 29 I.L.M. 1454 (entered into force May 17, 1991); Resolution on Large-Scale Pelagic Driftnet Fishing and Its Impact on the Living Marine Resources of the World's Oceans and Seas, 44th Sess., Agenda Item 82(f), U.N. GAOR, U.N. Doc. A/RES/46/215 (1989), 29 I.L.M. 1555 (1990) (urging a moratorium on driftnet fishing on the high seas, but including no enforcement provisions).

114. *See* ALLEN L. SPRINGER, THE INTERNATIONAL LAW OF POLLUTION 132-34 (1983); Pierre-Marie Dupuy, *Overview of the Existing Customary Legal Regime Regarding International Pollution*, *in* INTERNATIONAL LAW AND POLLUTION 61 (Daniel Barston Magraw ed., 1992);

rule approach is buttressed by Principle 21 of the 1972 Stockholm Declaration, which provides that nation-states have "the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."[115] Similarly, the liability rule finds expression in the "Polluters Pay Principle," which holds that sources must pay the costs of international pollution.[116] In practice, however, liability for global environmental harm has rarely been adopted in binding international law and has been infrequently enforced.[117]

Alternatively, an administrative price instrument could employ ex ante Pigouvian taxes to force sources to pay the estimated external costs of their emissions of CFCs or GHGs, forest clearing, or fishing (or a system of coordinated national taxes on these activities).[118] Sources would then reduce the quantity of harm they cause to the point where their marginal costs of abatement begin to exceed the tax. International environmental taxes,

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L.F.E. Goldie, *International Principles of Responsibility for Pollution*, 9 COLUM. J. TRANSNAT'L L. 283, 306-07 (1970); Merrill, *supra* note 51, at 934; Constance O'Keefe, *Transboundary Pollution and the Strict Liability Issue*, 18 DENV. J. INT'L L. & POL'Y 145, 162-78 (1990); Joni S. Charme, Note, *Transnational Injury and Ultra-Hazardous Activity: An Emerging Norm of International Strict Liability*, 4 J.L. & TECH. 75 (1989).

115. Stockholm Declaration of the United Nations Conference on the Human Environment, Principle 21, 11 I.L.M. 1416, 1420. The preceding phrase of Principle 21 provides that states also have "the sovereign right to exploit their own resources pursuant to their own environmental policies." *Id.*

116. *See* Rio Declaration on Environment and Development, Principle 16, U.N. Doc. A/CONF.151/5/Rev.1 (1992), 31 I.L.M. 874, 879 ("National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution . . . ."); Patricia Birnie, *International Environmental Law: Its Adequacy for Present and Future Needs*, *in* THE INTERNATIONAL POLITICS OF THE ENVIRONMENT 51, 79-80 (Andrew Hurrell & Benedict Kingsbury eds., 1992) (discussing the espousal of the "Polluter Pays Principle" by the OECD and the EC).

117. *See* Merrill, *supra* note 51, at 957-67 (concluding that there has been a general "failure to achieve any kind of effective regime for collective control of transboundary pollution," and that imposition of liability for external pollution, whether by treaty regime or by adjudication, is "essentially nonexistent"); *Developments in the Law—International Environmental Law*, 104 HARV. L. REV. 1484, 1500 (1991) ("[I]nternational liability remains an empty abstraction."); *cf.* Daniel Bodansky, *Customary (and Not So Customary) International Environmental Law*, 3 IND. J. GLOBAL LEGAL STUD. 105 (1995) (doubting the effectiveness of liability rules at the international level and advocating the development of regulatory treaty law).

118. Many countries have applied pollution taxes. *See* OECD, *supra* note 2, at 31-104; *see also* MIKAEL SKOU ANDERSEN, GOVERNANCE BY GREEN TAXES (1994) (comparing pollution tax systems in Germany, the Netherlands, Denmark, and France). A key difference between strict liability and taxes involves who gets the revenues: the victims or the government. *See* Kaplow & Shavell, *supra* note 5, at 738 n.77, 751-52. Economists argue that actual payments to victims may induce inefficient risk-taking behavior by victims. *See* BAUMOL & OATES, *supra* note 3, at 23-25, 29; Bohm & Russell, *supra* note 5, at 418, 434; Polinsky, *supra* note 5, at 16-36, 41-46. Another difference is that the tort liability system requires the victim (or her lawyer) to incur the costs of mounting litigation and proving facts to a jury, and the contingent fee system requires the victim to share her recovery with her lawyer, all of which may make the tort system a less certain internalizer of external costs than a Pigouvian tax would be. *See* Kaplow & Shavell, *supra* note 5, at 751-52.

however, have seldom if ever been imposed. Some international environmental treaties are funded by taxes,[119] but these are levies to raise revenues; they are not cost-internalizing Pigouvian taxes linked to the externality-associated activity, such as emissions or biodiversity depletion. In the future, it is conceivable that a global environmental tax could be established. An international tax approach has frequently been proposed to curb potential climate change.[120]

In practice, a more popular price-based approach has been global subsidies to encourage environmental protection efforts.[121] This technique is used today as part of official assistance provided to developing countries by the United Nations, the World Bank, other international organizations, and individual countries' bilateral development aid programs. Particular global environmental financing vehicles have included the Tropical Forestry Action Plan and the subsequent Brazilian Rainforest Trust, the Montreal Protocol's multilateral fund, and the FCCC's financial assistance requirements.[122] Much of this funding has been consolidated in the Global Environment Facility (GEF), launched in 1991 and made permanent in 1994.[123] Along these lines, new global financial assistance subsidies could be created to pay sources for abatement activities.[124]

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119. The World Heritage Convention, for example, is funded through a biennial tax on each party of 1% of the party's contribution to the regular budget of UNESCO. *See* Barrett, *supra* note 85, at 78.

120. *See* CLINE, *supra* note 9, at 346-56; MCKIBBIN & WILCOXEN, *supra* note 9, at 5-6; PIZER, *supra* note 9, at 2-3; Cooper, *supra* note 9, at 74-77.

121. Much of Pigou's original discussion suggested using "bounties" to polluters to induce pollution control. *See* PIGOU, *supra* note 3, at 183-86, 192-95. Professor Ellickson has remarked that Pigou's affinity for subsidies probably reflected the assumption in Pigou's era that "it was normal to pollute." Robert C. Ellickson, *Alternatives to Zoning: Covenants, Nuisance Rules, and Fines as Land Use Controls*, 40 U. CHI. L. REV. 681, 731 (1973). In Calabresian terms, if it is assumed that polluters begin with the entitlement to pollute, then they will have to be paid to relinquish it.

122. *See* Peter H. Sand, *Trusts for the Earth: New International Financial Mechanisms for Sustainable Development*, *in* SUSTAINABLE DEVELOPMENT AND INTERNATIONAL LAW 167, 175-82 (Winfried Lang ed., 1995).

123. *See* David Fairman, *The Global Environment Facility: Haunted by the Shadow of the Future*, *in* INSTITUTIONS FOR ENVIRONMENTAL AID 55, 83-84 (Robert O. Keohane & Marc A. Levy eds., 1996); Sand, *supra* note 122, at 175-77; *see also* Instrument for the Establishment of the Restructured Global Environment Facility, The World Bank, Mar. 16, 1994, 33 I.L.M. 1283 (restructuring the GEF and making it permanent); Global Environment Facility, Res. 91-5, Board of Executive Directors of the World Bank, Mar. 14, 1991, 30 I.L.M. 1758 (establishing the GEF).

124. *See* Stone, *supra* note 55, at 593-95, 613-14, 619-20 (endorsing subsidies for global biodiversity conservation). As a complementary matter, a rational global regulator might phase out current national subsidies that support environmentally damaging activities, such as subsidies for coal mining and combustion, agriculture, fishing, and deforestation. Energy subsidies alone account for a significant percentage of current global GHG emissions. *See* THE WORLD BANK, WORLD DEVELOPMENT REPORT 1992: DEVELOPMENT AND THE ENVIRONMENT 161 (1992). Agricultural subsidies can encourage additional CH_4 and N_2O emissions, as well as deforestation. Timber harvesting in many forests, including the U.S. National Forests, is government-subsidized. Harmonizing the rollback of economically inefficient subsidies would be similar to the tariff-reduction rounds of the GATT but would focus on domestic subsidies of environmentally injurious sectors. Because each country would worry about its competitive disadvantage if it tried

3. *Quantity Instruments: Property Rules, Performance Standards, and Tradeable Allowances*

Instead of regulating conduct or prices, a global environmental regulator might regulate the quantity of access to the shared global resource, or restated, the quantity of entitlements to cause external harm to the global environment.[125] The regulator could partition the property rights to what had formerly been treated as an open access resource, either via geographically defined property boundaries (e.g., fishing zones),[126] or via property entitlements to use the resource or cause harm. The sum of the individual entitlements would equal the aggregate amount of resource use or harmful activity deemed desirable.

Under a "pure" property rule assignment between one source and one victim, the entire entitlement to cause harm, or to be free from harm, would be assigned to one party. As Coase pointed out, subject to transaction costs between them, the source and victim might then bargain over reallocating the entitlement so that the higher-value user obtains the entitlement at a price the parties negotiate.[127] A variant more common in administrative regulation is a "divided" property rule in which the source is entitled to emit a defined fraction of its current or projected emissions, and the remaining fraction of the entitlement to emit is (implicitly) assigned to the victim as the cap on emissions.[128] The initial division of the entitlement can be seen as an administrative effort to replicate the bargain that the parties would have reached but for the obstacle of transaction costs.

In a world of multiple sources, the aggregate quantity entitlement to pollute would be subdivided among sources. Such quantity entitlements could be nontransferable across sources (that is, there could be a fixed performance standard for each source). Such fixed national emissions limits have been advocated for controlling GHGs, particularly by European governments.[129] Compared to conduct-based rules, such fixed quantity standards are more cost-effective because they give each source the flexibility to choose among internal compliance methods.

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to eliminate its own subsidies unilaterally, an international agreement may be necessary to "disarm" these subsidy regimes in multilateral unison. Because international competition to subsidize domestic industry leaves all countries worse off, reducing these subsidies worldwide could increase collective economic welfare as well as provide environmental benefits.

125. On the forms of quantity standards, see generally Gloria E. Helfand, *Standards Versus Standards: The Effects of Different Pollution Restrictions*, 81 AM. ECON. REV. 622 (1991).

126. *See* Hollick & Cooper, *supra* note 81, at 161.

127. *See* Coase, *supra* note 4.

128. *See* Ian Ayres & Eric Talley, *Solomonic Bargaining: Dividing a Legal Entitlement To Facilitate Coasean Trade*, 104 YALE L.J. 1027, 1078-80 (1995) (describing "activity-level" divisions of entitlements to emit); Polinsky, *supra* note 13, at 1087 (describing quantity limits as divided property entitlements).

129. *See* Sullivan & Jordan, *supra* note 10, at A1.

Yet even greater cost-effectiveness can be attained by allowing quantity entitlements to be transferable across sources—full property markets in transferable environmental access rights. These access rights are usually called marketable or tradeable "allowances."[130] Transferability gives each source the opportunity to sell unneeded entitlements to other sources, or to acquire additional entitlements from other sources. The aggregate amount of entitlements remains capped, but the location of entitlements varies with the cost of abatement. The United States and other countries have adopted tradeable allowance instruments in several environmental regulatory programs.[131]

Internationally, the Montreal Protocol employs a quantity-based constraint, setting phaseout targets for CFCs and related ozone-depleting substances released by industrialized countries, and setting upper limits on future growth in output of such substances by developing countries. Article 2(5) of the Montreal Protocol affords some flexibility to shift production of ozone-depleting substances among countries, as long as their combined phaseout schedules are satisfied, under the rubric of "industrial

130. One staunch advocate of free markets and property rights argues that tradeable environmental allowances are not "real" property markets because they are simply "a function of politically predetermined goals" instead of the result of private arrangements. Fred L. Smith, Jr., *Conclusion: Environmental Policy at the Crossroads*, *in* ENVIRONMENTAL POLITICS 177, 188 (Michael S. Greve & Fred L. Smith eds., 1992). But what Smith regards as "real" private property is just an entitlement enforced by judicial officials as opposed to administrative officials. All markets and all property rights depend on law. *See* PETER S. MENELL & RICHARD B. STEWART, ENVIRONMENTAL LAW AND POLICY 68 & n.28 (1994) ("Because a developed system of market exchange is dependent upon and structured by judicially enforced rules of property, contract, and tort, the existence of such a market system already represents one form of government 'intervention' . . . ."); CASS R. SUNSTEIN, FREE MARKETS AND SOCIAL JUSTICE 5 (1997) ("Free markets depend for their existence on law. We cannot have a system of private property without legal rules, telling people who owns what, imposing penalties for trespass, and saying who can do what to whom. . . . [M]arkets should be understood as a legal construct . . . ."); WORLD BANK, *supra* note 55, at 41 ("Without the rudiments of social order, underpinned by institutions, markets cannot function."). And even "private" property allocation by the judiciary can be intensely political. *See* ITAI SENED, THE POLITICAL INSTITUTION OF PRIVATE PROPERTY (1997). Moreover, however apt Smith's claim may be within a country that has an operating judicial system to adjudicate and enforce private property rights, global atmospheric externalities cannot be parceled into private hands by the judiciary (nor would most advocates of private property be eager to entrust such rights to an international judiciary). Some administrative global regime is necessary to create global environmental property rights.

131. Numerous national applications of tradeable allowances have been adopted in the United States since the early 1980s, including the programs to phase out lead in gasoline, to phase out chlorofluorocarbons (CFCs), to control the SO_2 emissions that yield acid rain, to control air pollution in Los Angeles, to control point and non-point sources of water pollution, to conserve selected fisheries, and to manage the development of sensitive lands. *See* Dudek et al., *supra* note 2, at 15-17, 23-25, 29-30, 36-37, 43-45; Robert W. Hahn & Gordon L. Hester, *Marketable Permits: Lessons for Theory and Practice*, 16 ECOLOGY L.Q. 361, 366-96 (1989). Other national programs of tradeable allowances include the New Zealand program to conserve fisheries, *see* Dudek et al., *supra*, at 44-45, and air pollution programs in Singapore and Germany, *see* Roger G. Noll, *Internationalizing Regulatory Reform*, *in* COMPARATIVE DISADVANTAGES? 319, 332 (Pietro S. Nivola ed., 1997).

rationalization."[132] The Protocol also allows "regional economic integration organizations," such as the European Union, to "jointly fulfill" their phaseout obligations under a combined "bubble."[133]

The climate change treaties also set quantitative limitations on emissions. In 1992, the FCCC adopted a hortatory target, obliging each industrialized country to take steps to limit its emissions with the "aim" of returning to its 1990 level by the year 2000.[134] Developing countries were also obliged to take measures to limit emissions, but no quantitative target was set.[135] The FCCC authorized an informal version of transferability, based on proposals by the United States and Norway, called "joint implementation."[136] Through joint implementation, parties can reduce their GHG emissions by investing in mutually agreed upon projects undertaken in other countries' territories.[137] Joint implementation represents an "informal" emissions trading market[138] because the international agreement does not allocate formal quantitative allowances. Instead, emitters can invest in abatement services in other countries, sharing the credit as they negotiate.[139] But joint implementation was sharply limited in 1995, when the Conference of the Parties (COP) adopted criteria for a "pilot phase" of joint implementation (through the year 2000) under which it expressly

132. Montreal Protocol, *supra* note 34, at art. 2(5), 26 I.L.M. at 1553; *see also* Peter Bohm, *Efficiency Issues and the Montreal Protocol on CFCs*, *in* 2 THE ENVIRONMENT AND EMERGING DEVELOPMENT ISSUES 308, 311, 318-19 (Partha Dasgupta & Karl-Göran Mäler eds., 1997) (describing flexibility provisions in the Montreal Protocol).

133. Montreal Protocol, *supra* note 34, at art. 2(8), 26 I.L.M. at 1553; *see* GURUSWAMY & HENDRICK, *supra* note 67, at 164-65.

134. *See* FCCC, *supra* note 39, at art. 4(2)(b), 31 I.L.M. at 857.

135. *See id.* at art. 4(1), 31 I.L.M. at 855.

136. *See id.* at art. 4(2)(a), 31 I.L.M. at 856 ("These parties may implement such policies and measures jointly with other Parties . . . ."); *see also Report of the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change*, 5th Sess., U.N. Doc. A/AC.237/18 (Part II)/Add.1 (1992), pt. 2, 31 I.L.M. 849, 851. On the genesis of the provision for "joint implementation," see Karin Arts et al., *Part 1: Legal and Institutional Aspects*, *in* JOINT IMPLEMENTATION TO CURB CLIMATE CHANGE 1, 8-14 (Onno Kuik et al. eds., 1994); Jonathan B. Wiener, *Joint Implementation To Curb Climate Change*, 4 REV. OF EUR. COMMUNITY & INT'L ENVTL. L. 218 (1995) (book review); and Stewart & Wiener, *Global Climate Policy*, *supra* note 11, at 104-05 & nn.74-76.

137. *See* TASK FORCE ON THE COMPREHENSIVE APPROACH TO CLIMATE CHANGE, U.S. DEP'T OF JUSTICE, A COMPREHENSIVE APPROACH TO ADDRESSING POTENTIAL CLIMATE CHANGE 77 (1991); Gro Harlem Bruntland, Remarks at the MIT/CICERO Global Change Forum (June 13, 1996), *reprinted in* Schmalensee, *supra* note 75, at 9 (stating that "the basic principles" of the FCCC are "cost-effectiveness, equity, joint implementation, and comprehensiveness"); Stewart & Wiener, *Global Climate Policy*, *supra* note 11, at 104-05 n.75; U.S. Dep't of State, Materials for the Informal Seminar on U.S. Experience with "Comprehensive" and "Emissions Trading" Approaches to Environmental Policy 7-8 (Feb. 3, 1990) (unpublished manuscript, on file with *The Yale Law Journal*).

138. The characterization of joint implementation as "informal emissions trading" was advanced in Stewart & Wiener, *Global Climate Policy*, *supra* note 11, at 104-05; and Jonathan B. Wiener, *The Comprehensive Approach, Greenhouse Taxes, and Informal Emissions Trading*, *in* OECD, CLIMATE CHANGE: DESIGNING A PRACTICAL TAX SYSTEM 163, 171-72 (1992).

139. *See* Groundrules for U.S. Initiative for Joint Implementation, 59 Fed. Reg. 28,442 (1994).

disallowed the receipt of any "credits" for extraterritorial abatement investments.[140] Without credits to record in satisfaction of their own emissions abatement obligations, the incentive for emitters to invest in joint implementation was muted.[141] The pilot phase thereby created a Catch-22. If no one participated in the pilot phase, critics would label joint implementation a failure; but if there were substantial participation, critics would assert that credits are unnecessary.

The Kyoto Protocol, signed in December 1997,[142] makes "quantitative emission limitation and reduction obligations" binding on industrialized countries. It sets targets ranging from eight percent below to ten percent above each country's 1990 level of greenhouse gas emissions (including a six percent reduction for Japan, a seven percent reduction for the United States, an eight percent reduction for the European Union, and increases for some countries such as Norway and Australia), to be achieved by the "commitment period" of 2008 to 2012. Together, these targets amount to an overall reduction for all industrialized countries of about five percent below the 1990 level.[143] In addition, following the U.S. proposal[144] (endorsed in a statement by over 2000 economists, including several Nobel

140. *See* FCCC, Conference of the Parties, First Session, Berlin, Mar. 28-Apr. 7, 1995, *reprinted in* 34 I.L.M. 1671 (1995).

141. Investors might still be motivated to use the pilot phase of joint implementation to pursue public relations rewards, to learn about joint implementation and make international contacts in anticipation of participating in a full GHG trading market, to satisfy non-FCCC emissions limits such as national or state/provincial requirements that do grant credit for overseas abatement, and to make early investments in projects that could generate real credits after the pilot phase of joint implementation ends.

142. *See* Kyoto Protocol, *supra* note 41.

143. *See id.* at art. 3 & Annex B, 37 I.L.M. at 33-34, 42 (setting quantitative emissions limitation and reduction obligations for industrialized countries); *see also Global Warming: Rubbing Sleep from Their Eyes*, ECONOMIST, Dec. 13, 1997, at 38 (stating that the Kyoto Protocol would require industrialized countries, as a group, to achieve overall emissions reductions of 5.2% below 1990 levels by the period from 2008 to 2012).

144. *See* BUREAU OF OCEANS AND INT'L ENVTL. & SCIENTIFIC AFFAIRS (OES), U.S. DEP'T OF STATE, SUBMISSION OF DOCUMENTS TO UN FCCC (June 4, 1997). The United States viewed the inclusion of emissions trading as crucial to the success of the Kyoto Protocol. *See Climate Change: Emission Trades, Not Joint Implementation, Likely Part of Kyoto Pact, EPA Official Says*, [Nov. 21, 1997] 28 Env't Rep. (BNA) 1409-10 ("Both trading and joint implementation are hallmarks of the U.S. proposal for the new climate change deal . . . ."); John J. Fialka, *Breathing Easy: Clear Skies Are Goal as Pollution Is Turned into a Commodity*, WALL ST. J., Oct. 3, 1997, at A1 ("The Clinton administration has made trading a main part of its negotiating position on the treaty to prevent global warming."); *Remember Global Warming?*, *supra* note 72 ("The United States would have rejected the Kyoto Protocol if it had not [allowed] the sale or trade of emissions allowances among nations."); William K. Stevens, *Kyoto Meeting Moves Closer to Agreement on Greenhouse Gases*, N.Y. TIMES, Dec. 10, 1997, at A2 ("[U.S. chief negotiator Stuart] Eizenstat said the revised American target was contingent on the acceptance of a comprehensive package that includes the 'trading' of emissions among countries and regions."); *Global Warming Accord: "Tough" or a "Farce"?* (last modified Dec. 11, 1997) <http://www.cnn.com/EARTH/9712/11/climate.conf.reaction.reut/index.html> ("'We got what we wanted, which was joint implementation, emissions trading, a market-oriented approach . . . ,' [President] Clinton said [of the Kyoto Protocol agreement].").

laureates[145]), the Kyoto Protocol authorizes a formal international system of tradeable emissions allowances among the industrialized countries.[146] For trade with developing countries, the Kyoto Protocol created a "Clean Development Mechanism" (CDM) that will accept contributions from industrialized countries, invest in emissions abatement in developing countries, and obtain "certified emission reductions" in return, which it will credit toward the industrialized investor countries' targets.[147] The Clean Development Mechanism can be seen as a vehicle for "joint implementation with credit," but potentially through a centralized fund rather than through decentralized bilateral investments.[148] The detailed rules for the Clean Development Mechanism and for formal allowance trading under the Kyoto Protocol have not yet been finalized.[149]

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145. *See* Arrow et al., *supra* note 11; *see also* Passell, *supra* note 11, at D2 (reporting on the letter signed by over 2000 economists endorsing a tradeable allowance system to deal with global warming).

146. *See* Kyoto Protocol, *supra* note 41, at arts. 3(10), 3(11), 17, 37 I.L.M. at 34, 39. The Kyoto Protocol also authorized continued joint implementation among industrialized countries. *Id.* at art. 6, 37 I.L.M. at 35. And it authorized regional emissions "bubbles" by providing for groups of countries to elect to "jointly fulfill their commitments" by aggregating their combined emissions targets. *Id.* at art. 4, 37 I.L.M. at 34. This "bubble" provision was mainly of interest to the European Union, though it could also be employed by other groups, perhaps including the signatories of NAFTA. I have discussed elsewhere the legal parameters of a formal international allowance trading system, *see* RICHARD B. STEWART, JONATHAN B. WIENER, & PHILIPPE SANDS, LEGAL ISSUES PRESENTED BY A PILOT INTERNATIONAL GREENHOUSE GAS TRADING SYSTEM (1996).

147. Kyoto Protocol, *supra* note 41, at arts. 3(12), 12, 37 I.L.M. at 34, 38.

148. There is yet the possibility that the Clean Development Mechanism will launch a decentralized market. Article 12(9) of the Kyoto Protocol states that participation in the Clean Development Mechanism "may involve private and/or public entities." Kyoto Protocol, *supra* note 41, at arts. 12(9), 37 I.L.M. at 38. But Article 12 requires the activities of the Clean Development Mechanism to be guided by an executive board, *see id.*, suggesting that the Clean Development Mechanism will be a more centralized conduit for investment in certified GHG reductions from developing countries, in contrast to the more wide-open market for emissions trading authorized among industrialized countries under Articles 6 and 17; *see id.* at arts. 6, 17, 37 I.L.M. at 35, 40.

149. Quantity instruments could also be used to protect global biodiversity. A quantity-based approach to forest conservation could involve assigning limited allowances for the annual conversion of forests to non-forest status. Or it could involve assigning quantity-based forest conservation obligations to countries. Both conversion allowances and conservation obligations could be made tradeable. An informal conservation market already occurs through "debt-for-nature swaps," in which there is no global quantity constraint on forest clearing, but the pro-conservation tastes of consumers, shareholders, and voters motivate financial institutions and governments to exchange discounted financial assets for ad hoc forest conservation investments.

For global fisheries, a quantity-based rule would involve limiting the allowable catch on the high seas. Tradeable fish catch quotas (typically called "individual transferable quotas," or ITQs) are becoming more common in national fisheries law, having been adopted by New Zealand, Canada, Iceland, Australia, and the United States. *See* PETER A. PEARSE, BUILDING ON PROGRESS: FISHERIES POLICY DEVELOPMENT IN NEW ZEALAND (1991); Kirsten M. Batkin, *New Zealand's Quota Management System: A Solution to the United States' Federal Fisheries Management Crisis?*, 36 NAT. RESOURCES J. 855, 864-71 (1996); Dudek et al., *supra* note 2, at 44-45; Carrie A. Tipton, *Protecting Tomorrow's Harvest: Developing a National System of Individual Transferable Quotas To Conserve Ocean Resources*, 14 VA. ENVTL. L.J. 381, 400-02 (1995); *A Sustainable Stock of Fishermen*, ECONOMIST, Jan. 19, 1991, at 17-18. But ITQs are

C. *The Optimal Instrument Under Unitary Fiat*

To test whether differences in the underlying legal framework affect the choice of regulatory instrument, I begin from a baseline comparison of the regulatory instruments under the hypothetical assumption of Unitary Fiat. This Section shows that, under Unitary Fiat, optimal instrument choice for global environmental problems generally conforms to the three presumptions of the standard analysis of local environmental problems: (1) incentive instruments are superior to conduct instruments; (2) subsidies are inefficient; and (3) taxes may be superior to tradeable allowances.

1. *The Case for Incentive Instruments*

After several decades of theoretical argument and practical experience at the national level, there is now virtual consensus that incentive instruments—taxes and tradeable allowances—are presumptively superior to conduct-based technology standards and fixed performance standards.[150] This Subsection examines this presumption in the context of global environmental problems by reviewing five key attributes that distinguish the alternative instruments: cost effectiveness, dynamic innovation, administrative cost, fairness, and morality. The Subsection shows that, under Unitary Fiat, the presumption in favor of incentive instruments remains robust at the global level.

First, incentive instruments (taxes and tradeable allowances) would be more cost-effective than conduct instruments and fixed performance standards. Cost-effectiveness is the ability of a regulatory instrument to

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only nascent in international fisheries law. UNCLOS requires countries to limit the allowable catch of fish within their 200-mile Exclusive Economic Zones (EEZs), to prevent over-exploitation, and to promote optimum harvest levels. *See* UNCLOS, *supra* note 48, at arts. 61, 62, 21 I.L.M. at 1281-82. But UNCLOS leaves the determination and enforcement of allowable catches within the EEZs to national governments; there is no international regime for limiting the quantity of fish extracted. Fishing within the 12-mile territorial sea of each country is wholly subject to that country's laws (without any international duty to set allowable catch limits). *See id.* at arts. 2-3, 21 I.L.M. at 1272. And UNCLOS allows essentially open access to fish on the high seas, subject only to general requirements to conserve fish and cooperate with other countries (for example, through setting allowable catches under regional fisheries treaties). *See id.* at arts. 116-19, 21 I.L.M. at 1290-91. In practice, this approach has not been successful; the regional fisheries agreements "have had no power to control the consumption [of fish by] non-member distant water flagships." GURUSWAMY & HENDRICKS, *supra* note 67, at 284. In response, the Agreement on Straddling Fish Stocks adopted additional measures to prevent overfishing, including requirements that fishing vessels' flag states must cooperate with coastal states to develop regional fisheries conservation agreements. *See* Agreement on Straddling Fish Stocks, *supra* note 50, at arts. 5, 7, 8, 34 I.L.M. at 1550, 1552-54. These regional conservation agreements may employ catch limits, *see id.* at art. 7, 34 I.L.M. at 1552-53, and the Agreement adds enforcement powers, *see id.* at art. 21, 34 I.L.M. at 1563-65, but there remain no quantity-based catch limits on the high seas.

150. *See* Hahn & Stavins, *supra* note 2; Hanson & Logue, *supra* note 14, at 1174.

minimize costs for a given level of environmental protection, or alternatively to maximize environmental protection for a given level of cost expenditure.[151] If abatement costs vary across sources, then cost-effectiveness can be improved by choosing a regulatory instrument that obtains more abatement from lower-cost abaters.

Taxes and tradeable allowances can both achieve this cost-effectiveness condition. Under taxes, each source abates up to the point that its marginal cost of abatement equals the tax on the next unit of emissions. High-cost abaters undertake less abatement and pay more taxes; low-cost abaters undertake more abatement and pay fewer taxes. Under tradeable quantity limits, the government sets a limited number of emissions allowances and requires sources to hold an allowance for each unit of emissions. Sources can then buy or sell emissions allowances in the market. Each source abates up to the point that its marginal cost of abatement equals the market price for an allowance to cover the next unit of emissions. High-cost abaters undertake less abatement and buy more allowances; low-cost abaters undertake more abatement and sell allowances. In principle, the price (tax) and quantity (tradeable entitlement) instruments can achieve identical cost-effectiveness. The tax rate set to induce a given level of emissions, say Q, would equal the market price of tradeable allowances if the government assigned Q emissions allowances.[152]

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151. Maximizing cost-effectiveness is important because it saves resources that can be used for other important social goals, such as additional environmental protection, eradicating poverty, improving health care, or supporting education. Lowering the price per unit of environmental protection can also increase the equilibrium quantity of environmental protection undertaken. Baumol and Oates note:

> If we cannot achieve our professed environmental objectives in a reasonably efficient way, it is likely that it will be these objectives, and not industrial performance, that will have to give. Thus, the standards of environmental quality that society is willing to accept may themselves depend upon the efficiency of the policy instruments we adopt to achieve the standards.

BAUMOL & OATES, *supra* note 3, at 189. For example, with cross-source trading, the lead phasedown apparently achieved the goal of 0.10 grams of lead per gallon of gasoline at the same cost that a policy without trading would have reached at 0.25 grams per gallon. In this sense, trading enabled EPA to "buy" a control level that was more than 50% more stringent than the nontrading control level with no increase in economic cost or political resistance. *See* Dudek et al., *supra* note 2, at 24-25 (citing analysis and views of EPA official Barry Nussbaum). Similarly, in 1990, Congress appeared to cut SO_2 emissions more stringently with trading—by 10 million tons—for the same total cost that it would have had to spend to achieve only an eight million ton reduction under a policy without trading. Given the implicit budget constraint imposed on the Clean Air Act amendments debate by the Bush Administration and by Congress's own expectations of public and industry reaction, employing the more cost-effective regulatory instrument may have translated into substantially more stringent regulation at the same cost. *Cf.* Lisa Heinzerling, *Selling Pollution, Forcing Democracy*, 14 STAN. ENVTL. L.J. 300, 318-36 (1995) (arguing that the stringency versus cost debate regarding the 1990 CAA amendments was not explicit).

152. *See* Weitzman, *supra* note 5, at 477. This identity holds only if the government faces no uncertainty about sources' true marginal costs of abatement. Because, in reality, there is such uncertainty, the price and quantity instruments may diverge. *See id.*; *see also infra* Subsection III.C.3 (comparing taxes and tradeable allowances).

Theory and experience in the United States show that conduct rules and fixed performance standards impose substantially higher costs per unit of abatement than incentive-based taxes and tradeable allowances, sometimes as much as ten times higher.[153] Substantial cost-effectiveness gains have been achieved in practice by the allowance trading programs for the lead phasedown and acid rain programs in the United States.[154]

Because abatement costs vary considerably around the world, the cost-effectiveness advantages of incentive instruments for addressing global environmental problems, as compared to conduct rules and fixed quantity rules, appear to be quite large. Several studies of policies to limit global GHG emissions show that allowing flexibility in the location of GHG emissions abatement would cut the estimated global cost, compared to an

153. Incentive-based price and quantity rules appear to reduce the cost per unit of pollution control by 25%-90% compared to command-and-control rules. *See* T.H. TIETENBERG, EMISSIONS TRADING 38-50 (1985); Robert C. Anderson et al., *Cost Savings from the Use of Market Incentives for Pollution Control*, *in* MARKET-BASED APPROACHES TO ENVIRONMENTAL POLICY 15 (Richard F. Kosobud & Jennifer M. Zimmerman eds., 1997); Maureen L. Cropper & Wallace E. Oates, *Environmental Economics: A Survey*, 30 J. ECON. LITERATURE 675, 686 (1992); Gruenspecht & Lave, *supra* note 103, at 1507, 1538-39.

154. *See* Hahn & Hester, *supra* note 131, at 387 (describing an EPA estimate of hundreds of millions of dollars in cost savings from the lead trading program); Paul L. Joskow et al., *The Market for Sulfur Dioxide Emissions*, 88 AM. ECON. REV. 669 (1998) (presenting data showing efficiency gains from the tradeable allowance program for sulfur dioxide emissions); Richard Schmalensee et al., *An Interim Evaluation of Sulfur Dioxide Emissions Trading*, 12 J. ECON. PERSP. 53 (1998) (same); *see also Revised Federal Rule-Making Procedures: Hearing on S. 981 Before the Senate Comm. on Governmental Affairs*, 105th Cong. (1997) (statement of C. Boyden Gray, Partner, Wilmer, Cutler & Pickering; Chairman, Citizens for a Sound Economy; and Former Counsel to the Presidential Task Force on Regulating Relief) ("The acid rain program . . . is producing benefits 140% ahead of schedule—at less than one-fourth the cost."). In the SO_2 case, the observed cost savings under the acid rain title of the 1990 Clean Air Act reflected the shift from the prior command-and-control technology requirements to both: (1) intra-facility compliance flexibility under a performance standard; and (2) inter-facility flexibility via allowance trading. It is not yet clear how much of these cost savings should be attributed to each of these changes in policy design. In addition, cost savings may have resulted from fortuitous changes such as a lower-than-expected price of transporting low-sulfur coal by rail. *See* DALLAS BURTRAW, COST SAVINGS, MARKET PERFORMANCE, AND ECONOMIC BENEFITS OF THE U.S. ACID RAIN PROGRAM (Resources for the Future Discussion Paper No. 98-28, 1998).

GHGs and CFCs may be even better subjects for a policy with locational flexibility than these successful antecedents. First, GHGs and CFCs involve essentially no problem of local "hotspots" in which emissions "bunching" can escalate local damages. Second, the range of abatement costs for GHGs is likely to be larger than the range for SO_2 and other regional pollutants. Third, including abatement options not only for energy sector CO_2 but also for methane (CH_4) and CO_2 storage in forest sinks will open even lower-cost abatement options. *See* Stewart & Wiener, *Global Climate Policy*, *supra* note 11, at 83, 94 & n.45 (citing studies by DOE and the World Bank showing that including all GHGs lowers the cost of abatement, compared to a CO_2-only policy, by about 75%, while including the forest sector lowers the cost of abatement, compared to an energy-sector only policy, by about 90%). Fourth, the global regulatory system is largely unfettered by prior regulatory systems, whereas the application of incentive-based programs in the United States in the 1980s and 1990s has been hindered by the need to graft these new regulatory instruments on top of preexisting technology-based conduct rules and fixed quantity limits. *See* Robert W. Hahn & Roger G. Noll, *Barriers to Implementing Tradable Air Pollution Permits: Problems of Regulatory Interactions*, 1 YALE J. ON REG. 63 (1983); Stavins, *supra* note 13, at 32.

equally stringent constraint on emissions without such locational flexibility (e.g., fixed national caps), by roughly fifty to seventy percent.[155] Compared to even less efficient regulatory instruments, such as global technology standards, the cost savings from these tradeable allowance instruments would be greater. Allowing a market in allowance trading only among industrialized countries without any participation by developing countries, as provided in the Kyoto Protocol, could still yield forty percent cost savings compared to requiring each industrialized country to control its emissions independently.[156] A recent experiment conducted among four Nordic countries with ostensibly similar abatement costs (Denmark, Finland, Norway, and Sweden) still found a fifty percent cost saving when locational flexibility was allowed.[157]

In the global climate context, a fifty to seventy percent cost saving is potentially huge. Several models suggest that a rough central estimate of the total global cost over the next three decades of holding GHG emissions in OECD member countries to twenty percent below their 1990 level by the year 2010, without flexible policy design, would be around $2 trillion (in a range of estimates from $1.5 trillion to $8 trillion).[158] Hence the fifty to seventy percent cost saving offered by locational flexibility would amount to approximately $1 trillion (in a range from $750 billion to $5.6 trillion) in savings. Significant cost savings could also have been realized for global CFC control if the Montreal Protocol had used full international allowance trading, instead of the more limited trade it allowed in production quotas and the fixed headroom it accorded to developing countries.[159]

Second, incentive instruments would more effectively stimulate dynamic innovation. Technology-based conduct rules are ostensibly intended to force adoption of cleaner technology, but they often turn out to

155. *See, e.g.*, JEAN-MARC BURNIAUX ET AL., THE COSTS OF REDUCING CO_2 EMISSIONS: EVIDENCE FROM GREEN (OECD Econ. Dep't Working Paper No. 115, 1992) (finding that emissions-trading regimes cut global costs by about 50% even once cross-country tax and subsidy distortions are eliminated); Manne & Richels, *supra* note 11 (discussing the significant cost reductions from "spatial efficiency"); Interagency Analytical Team, U.S. Gov't, Economic Effects of Global Climate Change Policies 17-21 (May 30, 1997) (unpublished manuscript, on file with *The Yale Law Journal*) (describing a "sizable reduction in costs" from emissions trading); Richels et al., The Berlin Mandate: The Design of Cost-Effective Mitigation Strategies 7 (1996) (unpublished manuscript, on file with *The Yale Law Journal*) (explaining that interregional flexibility cuts costs by more than 50%).

156. *See* EDWARD A. PARSON & KAREN FISHER-VANDEN, JOINT IMPLEMENTATION AND ITS ALTERNATIVES: CHOOSING SYSTEMS TO DISTRIBUTE GLOBAL EMISSIONS ABATEMENT AND FINANCE 5 & n.7 (Belfer Ctr. for Science and Int'l Affairs, Env't and Natural Resources Discussion Paper No. E97-02, 1997). A different study found more modest cost savings (in the range of 10-25%) within the G-7 group of countries if they use tradeable allowances instead of fixed national targets. *See* MABEY ET AL., *supra* note 70, at 367-68.

157. *See* PETER BOHM, A JOINT IMPLEMENTATION AS EMISSION QUOTA TRADE: AN EXPERIMENT AMONG FOUR NORDIC COUNTRIES (1997).

158. *See, e.g.*, Richels et al., *supra* note 155, at fig.3.

159. *See* Bohm, *supra* note 132, at 308, 317, 325-30.

stagnate innovation. Once the government specifies a particular required technology, or a fixed emissions limit, sources have no incentive to devise newer and better methods of control. And technology-based controls tend to involve more stringent requirements on new sources as opposed to existing sources, which discourage innovation and encourage emitters to keep older, dirtier equipment in operation longer.[160]

Incentive-based taxes and tradeable allowances promote dynamic innovation and diffusion because they give sources a continuous incentive to improve abatement methods. Sources can increase their profits by devising or adopting new abatement methods that are less costly than the expected cost of paying the tax or allowance price.[161] International allowance trading would create incentives for high-cost abaters in wealthier areas to look for opportunities to deliver new abatement methods (in return for freed-up allowances) particularly suited to the needs of sources in poorer areas.[162]

Third, incentive instruments would not involve undue administrative costs. Some argue that choosing and monitoring the installation of specific technologies might be less costly than measuring marginal damages (in order to determine where to set a price or quantity constraint) and

160. *See* Ackerman & Stewart, *Reforming*, supra *note* 2, at 1335-36; Dudek et al., *supra* note 2, at 13-14; Howard K. Gruenspecht, *Differentiated Regulation: The Case of Auto Emissions Standards*, 72 AM. ECON. REV. 328 (1982); Gruenspecht & Lave, *supra* note 103, at 1507, 1538-39.

161. *See* Fisher et al., *supra* note 70, at 413; Adam Jaffe & Robert N. Stavins, *Dynamic Incentives of Environmental Regulations: The Effects of Alternative Policy Instruments on Technology Diffusion*, 29 J. ENVTL. ECON. & MGMT. S-43 (1995); Wesley A. Magat, *The Effects of Environmental Regulation on Innovation*, LAW & CONTEMP. PROBS., Winter-Spring 1979, at 4; Alan S. Miller, *Environmental Regulation, Technological Innovation, and Technology-Forcing*, 10 NAT. RESOURCES & ENV'T 64, 66-67 (1995); Scott R. Milliman & Raymond Prince, *Firm Incentives To Promote Technological Change in Pollution Control*, 17 J. ENVTL. ECON. & MGMT. 247 (1989); Richard B. Stewart, *Regulation, Innovation, and Administrative Law: A Conceptual Framework*, 69 CAL. L. REV. 1256 (1981).

162. Some have argued that international allowance trading could slow technological innovation. *See, e.g.*, David M. Driesen, *Free Lunch or Cheap Fix;* 26 B.C. ENVTL. AFF. L. REV. (forthcoming 1999); L.D. Danny Harvey & Elizabeth J. Bush, *Joint Implementation: An Effective Strategy for Combating Global Warming?*, ENVIRONMENT, Oct. 8, 1997, at 14, 36 ("If [joint implementation] ever became widespread, the pressure on industrialized countries to make major emissions reductions at home would be reduced. This in turn could encourage them to postpone immediate and necessary investments in energy research and development."). This argument is really an assertion that if the world's least-cost abatement opportunities are undertaken first, they would occur in developing countries. If this argument is correct, the world would be better off for having acted cost-effectively and would be worse off if it were forced to purchase climate protection in industrialized countries only at a higher cost. This argument may also be an assertion that the stringency of the global emissions constraint should be tightened to force investments in both forest conservation and new energy technologies. In neither case is this argument a reason to oppose international allowance trading. Furthermore, this argument neglects the incentives that international allowance trading would create to develop new technologies for deployment in *developing* countries.

monitoring actual emissions.[163] But merely monitoring the technology employed at each source may not be as environmentally effective as monitoring actual emissions. Sources may increase their activity levels or otherwise continue to emit despite compliance with the technology rule, or sources might surreptitiously evade the technology requirement. If the real goal of environmental protection is to control effects on the environment, not to dictate the internal conduct of sources, then it may be worthwhile to pay for the monitoring of actual emissions rather than to be satisfied with the monitoring of technology.[164] Further, even if one assumed equal ability to monitor environmental effectiveness, the administrative costs of selecting "best technology" or other conduct rules may turn out to be at least as high as the administrative costs of setting incentive levels. If the regulated industry typically has superior information about cutting-edge technologies, an agency attempting to replicate that knowledge base must invest considerable time and resources (as well as fend off industry's better-informed challenges to the agency's choice[165]), thus delaying implementation and raising the agency's administrative costs.[166] And even if the balance of administrative costs did favor a conduct instrument, the decision to select a conduct instrument on this rationale would require a judgment that its advantage in administrative costs would outweigh its

163. *See* Bohm & Russell, *supra* note 5, at 444; Latin, *supra* note 1, at 1271-73, 1331-32; Shapiro & McGarity, *supra* note 1, at 745-51. *But see* Ackerman & Stewart, *Democratic Case*, *supra* note 2, at 179-88 (arguing that command-and-control rules involve higher administrative costs than market-based incentive rules). Note that the claimed administrative ease of technology-based rules does not apply to fixed emissions limits; the latter, like taxes and allowance trading, also require monitoring actual emissions.

164. *Cf.* BREYER, *supra* note 2, at 278-79 (noting that monitoring the actual environmental performance of technology standards is quite difficult); John S. Applegate, *Worst Things First: Risk, Information, and Regulatory Structure in Toxic Substances Control*, 9 YALE J. ON REG. 277, 315-16 (1992) (noting that technology-based standards are an inaccurate surrogate for actual effects on environmental quality).

165. *See* BREYER, *supra* note 2, at 274, 279-80; Ackerman & Stewart, *Democratic Case*, *supra* note 2, at 174.

166. Advocates of conduct instruments suggest that technology requirements can approximate the least-cost pattern of controls through such maneuvers as industry subclassifications, variances, and other procedures for finely tailoring technology requirements to different sources. *See, e.g.*, Shapiro & McGarity, *supra* note 1, at 748. But tailoring conduct rules in this way requires the government to collect and process the vast amount of information needed to specify the most cost-effective conduct at each individual source. *See* Hanson & Logue, *supra* note 14, at 1264-65. The government must know what every source knows and must update that knowledge continuously. Regulatory specification of best technologies involves the costs of running a large expert bureaucracy. *See id.* at 1265 n.427 (comparing command-and-control regulation to central planning with its attendant exorbitant administrative costs); Richard B. Stewart, *Madison's Nightmare*, 57 U. CHI. L. REV. 335, 356 (1990) (same); Stewart, *supra* note 107, at 97-104 (same). By contrast, taxes and tradeable quantity entitlements induce cost-effective pollution control without expecting government omniscience, by using reconstituted market incentives to induce sources to choose their own least-cost compliance methods based on information known to the sources and continuously updated by the sources. *See* BAUMOL & OATES, *supra* note 3, at 160, 163-65; Stavins, *supra* note 13, at 3.

enormous disadvantage in abatement cost-effectiveness (say, $1 trillion in the global climate context).

Fourth, incentives can be just as fair as alternative instruments. Concern is often expressed that efficiency-enhancing regulatory policies may yield unfairness.[167] Meanwhile, economists frequently urge that fairness be ignored in the choice among regulatory instruments at the national level.[168] Yet fairness may be more important at the global level than at the national level because the disparity in wealth is even greater at the global level[169] and because the fiscal mechanisms for redistribution (such as progressive taxation and social welfare policies) are much weaker at the global level.

Developing countries worry that global environmental law may be an unfair form of "eco-imperialism" that renews colonial exploitation by restricting economic growth in poor countries for the benefit of wealthy countries. They argue that fairness requires the industrialized countries to "take the lead" in controlling GHG emissions before developing countries are asked to make any sacrifices in this effort, and that fairness to developing countries counsels against tradeable allowances or joint implementation because such flexibility would let industrialized emitters pay their way out of their fair share of sacrifice.[170] This view reflects, in part, the fact that poorer countries have other desperate needs and tend to put a lower priority on global environmental protection[171] and, in part, the historically larger contribution of industrialized countries to elevated GHG concentrations. It would be unfair, on this view, to make poorer developing countries worse off for a problem caused by wealthier industrial countries.[172]

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167. *See, e.g.*, STEVEN KELMAN, WHAT PRICE INCENTIVES? ECONOMISTS AND THE ENVIRONMENT 84-86 (1981); ARTHUR M. OKUN, EQUALITY AND EFFICIENCY: THE BIG TRADEOFF (1975).

168. A standard prescription is that "[c]oncern about the distribution of income has no bearing on the choice between property and liability rules. Income redistribution can be accomplished more efficiently through the use of the income tax and transfer arms of government than through the selection of legal rules to serve distributional goals." Kaplow & Shavell, *supra* note 5, at 744.

169. *See* Revesz, *supra* note 54, at 1341 (noting that "the differences in wealth and economic development are far more salient in the international community than in [national] federal systems"); *id.* at 1342 (observing that "distributional consequences . . . ought to play a far more salient role in evaluating [policies'] relative desirability" in the international setting).

170. *See* Harvey & Bush, *supra* note 162, at 39 ("Some believe that industrialized countries can demonstrate leadership only by reducing [their own] emissions. . . . Critics contend that joint implementation represents nothing less than a way to abdicate responsibility because it allows industrialized countries to avoid getting their own houses in order by purchasing emission offsets abroad."). Of course, the notion of requiring the industrialized countries to "get their own houses in order" before seeking participation by developing countries is a category mistake: The "house" at issue here is the *global oikos*, not each nation's house.

171. *See supra* notes 82-84 and accompanying text.

172. *See* Jose Vargas, *RFF Weathervane Webpage* (visited Dec. 1, 1997) <http://www.weathervane.rff.org> (arguing, as environmental minister of Brazil, that it is unfair to ask developing countries to sacrifice in order to address a problem caused by industrialized

In order to choose among regulatory instruments, however, these fairness concerns need to be viewed in a comparative context. Conduct instruments, performance standards, taxes, and tradeable allowances would all impose abatement costs on sources. Global taxes on GHG emissions or deforestation, for example, could be highly regressive, taxing billions of poor people in China and India to confer benefits on wealthier people elsewhere.[173] But tradeable allowances could be structured to achieve fairness for poorer societies. Poorer sources could be assigned "headroom" in their initial endowment of GHG emissions allowances (while wealthier sources would receive fewer allowances), enabling poorer societies to grow economically and to earn substantial revenues from the profitable sale of allowances to wealthier sources. Wealthier sources would still "take the lead" by paying the costs of global emissions abatement through allowance purchases from poorer sources. Poorer sources would be required to make no uncompensated reductions in future emissions; the burden of financing all reductions from the global baseline forecast would be placed on wealthier sources.

This system would benefit poorer societies. They would be able to sell extra allowances at a profit—a new and valuable asset.[174] The magnitude of financial flows to major developing countries generated by a GHG allowance trading market could be substantial, rising from approximately $10 billion to over $100 billion per year (in constant dollars) in future decades[175]—easily exceeding the funding level of the GEF ($2 billion over

countries); *cf.* CARL F. CRANOR, REGULATING TOXIC SUBSTANCES: A PHILOSOPHY OF SCIENCE AND THE LAW 127-28 (1993) (observing that corrective justice suggests exacting recompense from past sources of environmental harm); JOHN RAWLS, A THEORY OF JUSTICE (1971) (asserting that it is unjust to produce social gains if doing so harms the position of the worst-off class). Action by industrialized countries is also sometimes advocated on tactical grounds, as necessary to provide the "moral leadership" to persuade developing countries to go along. This hypothesis depends on whether developing countries, and international relations generally, are driven more by strategic national interests or by moral suasion. Note that leakage under a treaty exclusive to industrialized countries would render developing countries' economies more GHG-intensive over time, so that developing countries' national interests would be pulled farther and farther in the opposite direction of this hypothesized moral leadership.

173. *Cf.* d'Arge & Kneese, *supra* note 54, at 443 (noting that "[m]ost people would rebel at the thought of wealth transfers from the poorest people on earth to the richest" as a result of global taxes on deforestation).

174. *See* PARSON & FISHER-VANDEN, *supra* note 156, at 4-5; Scott Barrett, *Transfers and the Gains from Trading Carbon Emission Entitlements in a Global Warming Treaty, in* COMBATING GLOBAL WARMING: STUDY ON A SYSTEM OF TRADEABLE CARBON EMISSION ENTITLEMENTS (1992); Manne & Richels, *supra* note 11, at 209.

175. *See* JOAQUIM OLIVEIRA-MARTINS ET AL., THE COSTS OF REDUCING CO_2 EMISSIONS: A COMPARISON OF CARBON TAX CURVES WITH GREEN 39 tbl.10 (OECD Econ. Dep't Working Paper No. 118, 1992). The size of these resource flows depends on the stringency of the overall target, the initial allocation of allowances, and the shapes of countries' marginal cost curves. This study examined a policy requiring a two percentage point per year reduction in the growth rate of CO_2 emissions from baseline forecasts by all countries, which approximately corresponds to capping global aggregate CO_2 emissions at their 1990 levels by the year 2050, including cutting emissions sharply in the OECD member states while letting emissions grow (though more slowly

four years), total World Bank environmental funding (about $1.6 billion in 1991), and even total Overseas Development Assistance (ODA) (now about $45 billion).[176] This would represent only the level of financial flows from GHG allowance trading, which could be augmented by the financial resources leveraged under similar market-based regimes for other global environmental issues such as CFCs, biodiversity, forests, and oceans.[177] The basic logic of contract—voluntary exchange—means that allowance transactions would not occur unless the seller is made better off. Allowance sales would bring local benefits of GHG abatement to poorer cities, such as reductions in the high levels of local air pollution associated with coal burning.[178]

Moreover, the intuition that poorer societies would gain from being left out of any GHG abatement obligations turns out to be suspect. A regulatory system limited to sources in wealthy countries ("Annex I" under the FCCC) could actually be more costly for poorer countries than a cost-effective regulatory system involving global allowance trading. This is because the higher cost to wealthier sources will mean slower economic growth in wealthier countries and therefore reduced purchases of goods and services from poorer countries. In other words, developing countries could be net losers under an emissions control rule exclusive to industrialized countries, but net gainers—better off even than if *no* action were taken by anyone—under a policy that restricted global emissions and allowed industrialized countries to obtain abatement services worldwide from developing countries through developing countries' sales of headroom allowances.[179]

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than in the baseline forecast) in developing countries. It found that CO_2 allowance trading would yield resource flows (in constant 1985 dollars) to China, India, and the former USSR of about $14 billion in 2000, about $86 billion in 2020, and about $206 billion in 2050. *See id.* It found that these allowance sales would shift China and Russia, the two main allowance sellers, *see id.*, from net losers to net gainers, *compare id.* at 38 tbl.8 (Scenario II), *with id.* at 40 tbl.12 (Welfare). At the same time, it found that global GDP losses and OECD-member GDP losses would be reduced by about 50% or more, compared to a nontrading regime. *Compare id.* at 38 tbl.8 (Scenario II, "World" and "Total OECD" columns), *with id.* at 40 tbl.12 (GDP, "World" and "Total OECD" columns).

176. *See* Kenneth Piddington, *The Role of the World Bank*, *in* THE INTERNATIONAL POLITICS OF THE ENVIRONMENT, *supra* note 116, at 212, 225.

177. *See* Suzi Kerr, *Environmental Aid*, ENVIRONMENT, Jan.-Feb. 1997, at 3, 3-4.

178. As one measure of the local benefits of making environmental protection investments in poorer countries, consider that a dollar spent on environmental regulation in poorer countries saves approximately 300 to 1500 times more life-years than the same dollar spent to control pollution under current regulations in the United States. *See* Robert W. Hahn, *Regulatory Reform: What Do the Government's Numbers Tell Us?*, *in* RISKS, COSTS, AND LIVES SAVED: GETTING BETTER RESULTS FROM REGULATION 208, 237 (Robert W. Hahn ed., 1996).

179. *See* Manne & Richels, *supra* note 11, at 209; Richels et al., *supra* note 155, at 6-7. Trading could benefit developing countries under other global environmental regimes as well. Under the Montreal Protocol, developing countries were afforded longer timelines to limit CFC consumption and were entitled to consume CFCs up to a far larger number of units per capita than their current usage rates. These provisions amount to the assignment of extra "headroom"

Saying that industrialized countries must control their emissions at home, not overseas, could be profoundly *un*fair to developing countries. It is like insisting that rich people must only spend their money in rich neighborhoods and must never invest in poorer neighborhoods. Denying developing countries the revenues from allowance sales in the name of fairness to developing countries is particularly ironic, given that many developing countries (notably excepting small island states) may perceive far greater economic and environmental rewards from allowance sale revenues today than they would from global environmental protection long in the future.[180]

Fifth, incentives do not represent immoral means of achieving environmental protection. Some favor conduct instruments over incentive instruments on the view that translating environmental protection into

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entitlements to developing countries. But because these entitlements were not tradeable under the Montreal Protocol, developing countries could not earn revenues from their sale. A formal system of tradeable CFC consumption allowances could have made the developing countries just as well off as this headroom, with lower total global costs, or much better off at the same global cost. *See* Bohm, *supra* note 132, at 327.

A market-based approach to fisheries conservation would also be more fair to developing countries. Under the UNCLOS, *supra* note 48, coastal nations can exercise exclusive fishing rights within their 200-mile EEZs. The expansion of these fishing zones from 12 to 200 miles amounts to assigning a large share of what were formerly shared global ocean resources to the coastal nations. The coastal nations are called on to negotiate regional seas treaties to conserve fish on the high seas outside the 200-mile EEZs, but only with "relevant" countries—that is, only with those countries with fishing fleets operating in the relevant regional sea. This arrangement implicitly excludes noncoastal countries without fishing fleets from rights to harvest fish on the high seas. It also gives such countries a perverse incentive to invest in new or increased fishing in order to gain status as "relevant"—thereby increasing world fishing capacity and further stressing global fisheries. By contrast, an international system of tradeable catch allowances would be more fair. It would make the initial distribution of rights transparent, thereby inviting a fairer assignment to all countries. Nonfishing countries, including landlocked developing countries, could then obtain initial assignments of some catch allowances and either use them for their own fishing fleets or earn revenues by selling their excess allowances to fishing countries. Moreover, because the aggregate global fishing allowances would be capped and assigned, this system would avoid the perverse incentive to become "relevant" by investing in increased fishing capacity.

A market-based global forests regime would also have equity advantages. Under a treaty restricting all countries' forest losses, developing countries would be burdened particularly harshly if their forest clearing was rising as they developed economically, whereas industrialized countries would be relatively unregulated if their forests were expanding after several centuries of deforestation. But under a treaty assigning tradeable forest protection obligations in proportion to national income, developing countries would gain substantial income from selling forest protection services.

180. Even if developing countries considered a tradeable allowances system attractive for the reasons just outlined, they might still be concerned that the mechanics of competing in a market for international tradeable allowances might unfairly advantage sophisticated competitors from wealthy countries over less experienced and less well-capitalized participants from poorer countries. Transparency, capacity-building, and restraints on the unfair exercise of market power will therefore be important elements of any international tradeable allowances system. Multilateral development institutions like the World Bank, the GEF, the United Nations Development Programme, the United Nations Industrial Development Organization, and the United Nations Conference on Trade and Development, could play a significant role in conducting training programs for public- and private-sector actors from developing countries on how to participate successfully in global environmental allowance trading markets.

market prices and commodities debases the moral value of environmental protection. These critics worry that condoning the purchase and sale of the "right to pollute" fails to condemn the actor who causes increased pollution and thereby undermines the ethical norms that motivate environmental protection and boost compliance with environmental laws and regulations.[181]

While critics of incentives may feel the environment is too important to leave to markets, the better view is that environmental protection is too important to leave *out* of markets. Underlying this difference of views may be a deeper divergence in approaches to law and social progress. Advocates of conduct instruments may see environmental degradation as immoral misbehavior that requires personal ethical reform. Advocates of incentives, while not opposed to better ethics, may see environmental degradation as a dysfunction of the economic system that warrants reforming markets. They argue that failing to translate environmental protection into a market commodity leaves environmental protection outside market transactions, which is the reason they believe environmental protection is undersupplied in the first place.

Further, advocates of incentive-based policy offer several responses to the moral condemnation argument. First, all policies, except an absolute ban, amount to licensing some "right to pollute." Indeed, conduct-based technology requirements and fixed performance standards amount to a license to pollute *for free* once the requisite technology is installed or the quantity target is achieved. Taxes and tradeable allowances, by contrast, force the polluter to *pay* for *every* unit of emissions, either by paying the tax or by forfeiting the revenue from the sale of the allowance. Thus, it is conduct rules and fixed quantity rules, ironically, that truly license a right to pollute for free.

Rather than being amoral, price and tradeable quantity instruments may serve a competing moral vision.[182] Efficiency can also be a moral value.

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181. *See, e.g.*, Michael J. Sandel, Editorial, *It's Immoral To Buy the Right To Pollute*, N.Y. TIMES, Dec. 15, 1997, at A23 (arguing that "an international market in [greenhouse gas] emission credits would . . . undermine the ethic we should be trying to foster on the environment" because "turning pollution into a commodity to be bought and sold removes the moral stigma that is properly associated with it"). *See generally* KELMAN, *supra* note 167, at 27-91 (discussing the ethical "case for concern" about incentives).

182. Moreover, moral condemnation and incentive-based regulatory instruments are not mutually exclusive approaches to improving compliance; they can be pursued in combination. Moral opprobrium is deployed to discourage antisocial behavior of many types, including murder, drinking and driving, breach of contract and fiduciary obligations, and pollution. *See, e.g.*, David Charny, *Nonlegal Sanctions in Commercial Relationships*, 104 HARV. L. REV. 373, 409 (1990) (explaining that reputational interests promote contract performance); Kenneth G. Dau-Schmidt, *An Economic Analysis of the Criminal Law as a Preference-Shaping Policy*, 1990 DUKE L.J. 1 (explaining that shame sanctions promote deterrence); Dan M. Kahan, *What Do Alternative Sanctions Mean?*, 63 U. CHI. L. REV. 591, 638-41 (1996) (explaining that shame sanctions may be effective deterrents of criminal behavior); Richard H. McAdams, *The Origin, Development,*

Critics who concede the efficiency of incentives but say that opposition is warranted in the service of moral goals[183] may neglect that inefficiency is also arguably immoral because it wastes society's resources, depriving the needy of the benefits to which society could have put those resources.[184] In the global environmental context, eschewing incentives on "moral" grounds would imply both moral insensitivity to poorer populations and anthropocentric attention to ethical principles that matter only to humans, treating as morally expendable the millions of other species who share the Earth and would benefit from more cost-effective incentives for global protection.[185]

Unpeeling the moral case reveals an internal irony. Because incentives are more cost-effective, they generate more pollution control for a given expenditure, stimulate greater dynamic innovation in new methods of pollution reduction, and enable society to buy more environmental protection. If the moralist's claim is that "the person who causes more pollution is blameworthy and should be condemned," then, ironically, "the person who causes more pollution" is the moralist who opposes the more cost-effective instruments.

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and Regulation of Norms, 96 MICH. L. REV. 338 (1997) (explaining that esteem and shame foster compliance with social norms); Rose, *supra* note 5, at 38 (emphasizing the moral message communicated by environmental law). Shame can be a useful means of enforcing compliance with international law as well. *See* ABRAM CHAYES & ANTONIA HANDLER CHAYES, THE NEW SOVEREIGNTY 25-28 (1995). Yet society attaches shame not to all acts of a certain kind but to the subset of such acts that social and legal institutions label as illicit. Not all killing is condemned; self-defense is forgiven or even cheered while cold-blooded murder invokes condemnation (and vehicular homicide falls somewhere in between). Similarly, the moral message of environmental law should be not to condemn all pollution, from the factory smokestack to the daily routine of human excretion, but rather to distinguish excessive pollution from acceptable pollution. If so, incentive-based environmental law can apply shame just as well as can non-market-based law. Most goods and services are traded in markets while, at the same time, moral opprobrium is attached to the theft of someone else's property or unfair dealing. Likewise, using markets to protect the environment does not displace considerations of moral condemnation. A source that emits in excess of its allowances or without paying taxes would not only have to pay financial penalties but would also be subject to public shame and moral stigma for its theft of the community's shared environmental resource.

183. *See, e.g.*, Sandel, *supra* note 181, at A23 (noting that "[d]espite the efficiency of international emissions trading, such a system is objectionable" on moral grounds). For the purposes of his moral argument, he concedes that allowance trading would be "a more efficient way to reduce pollution than imposing fixed levels for each country." *Id.*

184. A similar point is made by Paul R. Portney, *Counting the Cost: The Growing Role of Economics in Environmental Decisionmaking*, ENVIRONMENT, Mar. 1998, at 14, 37 ("In one sense [] it is immoral *not* to take costs into account in setting environmental standards. . . . Failure to consider costs makes it impossible to get the most from the available resources and ultimately means saving fewer lives, preventing fewer illnesses, and protecting fewer species or areas than one otherwise could.").

185. *See* CHRISTOPHER D. STONE, EARTH AND OTHER ETHICS: THE CASE FOR MORAL PLURALISM (1987); Christopher D. Stone, *The Environment in Moral Thought*, 56 TENN. L. REV. 1, 2-4 (1988). Utilitarian theory need not exclude the interests of nonhumans. *See* RODERICK F. NASH, THE RIGHTS OF NATURE 23 (1989) (citing JEREMY BENTHAM, AN INTRODUCTION TO THE PRINCIPLES OF MORALS AND LEGISLATION 311 (Laurence J. LaFleur ed., Hefner Publ'g Co. 1948) (1789)).

Whatever the resolution of this debate, the moral case against incentives is far from ironclad. Given the substantial advantages of incentives for global environmental protection on other grounds discussed above, it is difficult to see the hard-line moral case against incentives winning the day. Most environmental advocates have indeed given up the "license to pollute" rhetoric over the past fifteen years, recognizing the effectiveness of incentives at controlling pollution and seeking instead the careful design of incentive instruments to ensure real environmental quality improvement.

2. *The Case Against Subsidies*

Subsidies can in principle achieve cost-effective abatement. The subsidy acts as a negative tax because failing to abate means incurring the cost of forgoing the subsidy. But abatement subsidies have the crucial drawback that they involve actual payments to pollution sources to cover the costs of abatement. Such payments generate perverse incentives for increased pollution. First, when polluters are paid the costs of abatement, they may behave ex ante as if they are insured against the costs of risk-making and increase their risk-making activities.[186] Second, sources may posture to secure larger subsidies by threatening to increase pollution, in part by increasing pollution in fact. Third, capital markets may respond to abatement subsidies by increasing investment in the polluting industry. Whereas a pollution tax reduces pollution at each firm and reduces the activity level of the entire polluting industry, an abatement subsidy reduces pollution at the individual firm but increases the activity level of the entire polluting industry. This is because the subsidy reduces the relative costs of operating a business in the polluting industry and thereby attracts new

186. On this ground, Judge Posner criticizes the result in *Spur Industries v. Del E. Webb Development*, 494 P.2d 700 (Ariz. 1972), in which the court ordered the polluting feedlot to shut down on the condition that the neighboring residential developer pay the feedlot's costs of abatement: "This is not a perfect solution, however, because entitlement to shutting-down costs or relocation costs will reduce the incentive of feedlot owners to locate their feedlots optimally with respect to projected development of the surrounding area." POSNER, *supra* note 100, at 64. Analogously, economists argue that fully compensating victims for their injuries (under liability rules) will induce victims to act as if insured against injury and thus to take more risks. This is the standard problem of victims' moral hazard under liability rules. *See id.* at 169-75, 177; Bohm & Russell, *supra* note 5, at 418, 434; Coase, *supra* note 4, at 42; Kaplow & Shavell, *supra* note 5, at 720-21, 738-39. For this reason, a corrective tax paid to the government is argued to be more efficient than a liability award paid to the victim. *See* BAUMOL & OATES, *supra* note 3, at 23-25, 29. Economists' preference for corrective taxes over abatement subsidies is based on the counterpart proposition that compensating risk-makers for their costs of abatement (under subsidies) will induce risk-makers to make more risk.

Of course, injury victims may never think themselves fully compensated by ex post monetary awards. And fairness or other criteria might still warrant compensating victims. Further, real-world liability rules could actually yield undercompensation because of the costs of mounting litigation, problems of proof, problems of enforcing judgments, and related obstacles.

entrants and greater investment in the polluting industry. This effect can potentially yield even more total pollution than before the subsidy was enacted.[187] International "carrots" subsidizing global environmental protection may likewise invite perverse behavior by sources and investors that increases global environmental harm.[188]

Meanwhile, environmental subsidies can also be problematic if they are administered through centralized aid institutions that enjoy market power. The centralized environmental funds do not have to compete (much) to sign up projects. Because each is the main or sole funding entity for a certain kind of financial assistance (ozone projects, climate projects, forest projects, etc.), it has fewer incentives to be cost-effective—to select good projects, to monitor performance, and to insist on or produce results—than if it had to compete to fund the best projects and to develop new and better ways of investing in environmental protection. From the perspective of potential aid recipients, the centralized fund looks like an investment cartel—a monopsonist exercising uncontested power to choose or reject environmental projects on behalf of its wealthy backers. It is no wonder that the developing countries and environmental organizations view this market power with distrust.

A final problem with subsidies is that they require the government to find money. Revenues must be raised, with the attendant social costs of distortionary taxes or fiscal deficits.[189]

3. *The Case for Taxes over Tradeable Allowances*

Among incentive instruments, taxes and tradeable allowances can theoretically produce identical results. But features of implementation in

187. *See* BAUMOL & OATES, *supra* note 3, at 211-28 (noting that abatement subsidies would reduce emissions at each firm but increase the size of the polluting industry and observing that using subsidies could conceivably increase net emissions); Wallace E. Oates, *Economics, Economists, and Environmental Policy*, 16 E. ECON. J. 289, 290 (1990) ("[I]n a competitive setting, [abatement] subsidies will lead to an excessively large number of firms and industry output.... [I]t is even conceivable that aggregate industry emissions could go up!" (citations omitted)). Further study has refined the Baumol and Oates "perverse subsidy" result. A perverse net increase in aggregate pollution will occur if pollution per unit of firm output is constant. But if abatement can reduce pollution per unit of output (i.e., change the technology of production), then the abatement subsidy may succeed in reducing overall pollution. *See* Robert E. Kohn, *When Subsidies for Pollution Abatement Increase Total Emissions*, 59 S. ECON. J. 77, 84-85 (1992). Still, even the abatement subsidy that does reduce aggregate pollution remains inferior to a tax on emissions: In general equilibrium modeling exercises, the best abatement subsidy still achieves an aggregate emission reduction far smaller than an equivalent emissions tax, and the worst abatement subsidy continues to increase aggregate emissions perversely. *See id.* at 83-84; Stuart Mestelman, *Production Externalities and Corrective Subsidies: A General Equilibrium Analysis*, 9 J. ENVTL. ECON. & MGMT. 186, 191 (1982).

188. *See* Howard F. Chang, *An Economic Analysis of Trade Measures To Protect the Global Environment*, 83 GEO. L.J. 2131, 2154-60 (1995).

189. The possibility of combining abatement subsidies with emissions taxes is addressed *infra* Part IV.

practice—uncertainty and revenue-recycling—may favor taxes under Unitary Fiat. Fairness may cut the other way.

First, uncertainty may favor taxes, at least where cost escalation is more worrisome than emissions escalation. In principle, a price instrument could generate the same cost-effectiveness gains as a quantity instrument. If the marginal costs and marginal benefits of abatement were known with certainty, the regulator could either set the optimal tax, knowing that it would induce a corresponding level of emissions, or set the optimal level of emissions (by issuing that many tradeable allowances), knowing that it would induce a corresponding marginal cost. The market price of a marginal allowance would precisely equal the tax rate set to achieve that level of emissions.

Under conditions of uncertainty about abatement costs, however, the price and quantity instruments diverge.[190] Setting a tax constrains the maximum marginal cost that sources would have to pay, but it yields an uncertain level of emissions. If sources' true costs of abatement are higher than the regulator predicted, the tax will generate less abatement and higher emissions. By contrast, setting a quantity of emissions constrains the maximum level of emissions, but it yields an uncertain cost. If sources' true costs of abatement are higher than the regulator predicted, the quantity limit will generate higher costs. Thus, a tax prevents compliance cost overruns but risks emissions overruns, while a quantity limit prevents emissions overruns but risks cost overruns. Given uncertainty, a determination of which risk is of greater social concern is thus an important factor in choosing between a quantity-based constraint and a price-based constraint under uncertainty.[191]

The relative importance of cost overruns versus emissions overruns, and hence the choice between price and quantity rules, depends on the relative slopes of the marginal cost and marginal benefits curves.[192] If the

190. *See* Weitzman, *supra* note 5. For a concise summary, see BREYER, *supra* note 2, at 273. A more technical review is provided in Gruenspecht & Lave, *supra* note 103, at 1507, 1516-19. *Cf.* Hanson & Logue, *supra* note 14, at 1266-70 (discussing the inability of regulators to obtain full information about costs and benefits).

191. Uncertainty about the position of the true marginal benefits curve (the environmental damage function) does not affect the choice between price and the quantity instruments, because it is the sources' true marginal cost curve that determines their actual abatement in response to the regulation. As discussed in the text, the *slope* of the marginal benefits curve does matter, because it affects the size of the social losses entailed by the price or quantity instruments.

Kaplow and Shavell argue that even if the regulator is uncertain about abatement costs, price rules are still universally more efficient than quantity rules if the regulator sets a tax schedule equal to the marginal harm caused by each level of emissions (as opposed to a single fixed tax rate). They argue that Weitzman and others have inappropriately limited their analysis to a fixed tax rate. *See* LOUIS KAPLOW & STEVEN SHAVELL, ON THE SUPERIORITY OF CORRECTIVE TAXES TO QUANTITY REGULATION (National Bureau of Econ. Research Working Paper No. 6251, 1997).

192. *See* BAUMOL & OATES, *supra* note 3, at 57-78; Gruenspecht & Lave, *supra* note 103, at 1516-18; Polinsky, *supra* note 13, at 1112; Robert N. Stavins, *Correlated Uncertainty and Policy*

benefits curve is steeper than the costs curve—meaning that as abatement is reduced and emissions grow, environmental damages rise more steeply than compliance costs fall—then an increment of emissions overrun is more socially harmful than an increment of cost overrun. In such cases of relatively steep benefits compared to costs, the quantity rule is the preferable choice. If, by contrast, the cost curve is steeper than the benefits curve—meaning that as abatement is reduced and emissions grow, compliance costs fall more steeply than environmental damages rise—then an increment of cost overrun is more socially harmful than an increment of emissions overrun. In such cases of relatively steep costs compared to benefits, the price rule is the preferable choice.[193]

Accounting for uncertainty in the global environmental context can make a significant difference in choosing between price and quantity rules. A recent study of global GHG abatement finds that, given significant uncertainty about true abatement costs, a tax would yield roughly *five times greater net benefits* than would a system of tradeable emissions allowances

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Instrument Choice, 30 J. ENVTL. ECON. & MGMT. 218 (1996); Stavins, *supra* note 6, at 313-16; Weitzman, *supra* note 5, at 483-87.

Richard Revesz has argued that if the optimal degree of abatement—the "how much" question—is selected not on the basis of economic efficiency calculations that seek to maximize net benefits by setting marginal benefit equal to marginal cost, but rather on the basis of some nonefficiency considerations of importance to political decisionmakers, then the relative slopes of the benefit and cost curves are irrelevant and the quantity rule is "decidedly preferable" to the price rule. *See* Revesz, *supra* note 103, at 466-67. The rationale is that if government has already selected the socially acceptable level of emissions ("how much") on non-efficiency grounds, the best the regulator can do is achieve that level of emissions as cost-effectively as possible ("how to"). Tradeable quantity allowances achieve the selected level of emissions more surely than do taxes, which could allow the actual level of emissions to deviate from the selected level when true costs are uncertain.

The validity of Revesz's point depends on a strong assumption about the insensitivity of the "how much" question to cost tradeoffs. Decisionmakers might be willing to tolerate some deviation from the selected level if the cost savings were large enough, unless they truly have inflexible deontological criteria for insisting on a particular level of emissions. Put another way, Revesz's case asks whether the politically determined level of emissions control really corresponds to a truly vertical marginal benefits curve, such that no decrease in cost could outweigh a minor increase in emissions, or whether the nonefficiency criteria just steepen the marginal benefits curve somewhat but can still be weighed against other social costs.

Meanwhile, it is also conceivable that political decisionmakers would select on nonefficiency grounds a desired amount of *social expenditure* on an environmental problem, rather than a level of emissions, in which case the price (tax) rule would "decidedly" achieve this selected cost more surely than would the quantity rule.

193. The quantity rule may, however, have an advantage under uncertainty when dynamic innovation is considered. *See* Gruenspecht & Lave, *supra* note 103, at 1518-19. The logic is that if investment in innovation is driven by the volume of abatement activity to which it can be applied, the price rule yields dynamic feedback effects that exacerbate its deviation from optimal abatement. A tax that yields overcontrol of emissions (because true abatement costs are lower than expected costs) will induce overinvestment in innovation, which further reduces abatement costs and further compounds the degree of overcontrol. A tax that yields undercontrol of emissions (because true abatement costs are higher than expected costs) will induce underinvestment in innovation, which keeps abatement costs high and compounds the problem of undercontrol. A quantity rule, by contrast, fixes the level of abatement and thus induces closer to optimal investment in innovation, with no perverse feedback effects.

intended to achieve the same level of abatement as the tax.[194] This finding depends on the view that the marginal damages from increased GHG emissions are fairly flat and the marginal costs from decreasing emissions rise more steeply.[195]

Second, instruments that raise revenue can be superior to those that do not. Taxes raise revenue. Technology standards and fixed emissions limits do not. Tradeable allowance systems can raise revenue if the allowances are initially sold to sources by the government, but not if the allowances are issued to the sources for free. If the revenues earned by an environmental tax (or allowance sale) are used to offset and reduce a preexisting tax that is relatively more distortionary than the environmental tax, then in addition to protecting the environment, the revenue-raising environmental policy also promotes social well-being in a second way, besides protecting the environment: It shifts the tax system from taxes on "goods" like labor to taxes on "bads" like pollution, not only discouraging the bads but also removing preexisting disincentives to the goods. This second benefit of revenue-raising environmental instruments, often called the "revenue-recycling effect" or the "double dividend," improves the net benefits of the environmental constraint in the presence of preexisting tax distortions.[196]

The upshot is that in the presence of preexisting tax distortions, a nonrevenue-recycling regulatory instrument is less cost-effective than a

194. *See* PIZER, *supra* note 9, at ii, 29.

195. *See id.* at 12-14, 16. Pizer compares the global imposition in 2010 of optimal price and quantity limits and finds that an optimal global CO_2 tax would yield net benefits in excess of $330 billion, whereas an optimal global tradeable allowance policy would yield net benefits of only $69 billion. *See id.* at 29. These estimates arise from simulations of numerous scenarios with varying marginal costs, reflecting ex ante uncertainty about true costs. *See id.* at 22-29. They also depend crucially on Pizer's view that marginal benefits of CO_2 emissions abatement are fairly flat, a premise he derives largely from the fact that global warming is induced by the stock of CO_2 in the atmosphere and, because CO_2 has a long residence time in the atmosphere, annual emissions of CO_2 (or their abatement) affect the atmospheric stock only slightly. *See id.* at 11-12, 16-17; *see also* MICHAEL HOEL & LARRY KARP, TAXES VERSUS QUOTAS FOR A STOCK POLLUTANT (Fondazione Eni Enrico Mattei Working Paper No. 29-98, 1998) (showing through a mathematical model that taxes dominate quantity limits for GHG emissions abatement because damages are sensitive to the change in the stock of GHGs, not the flow of emissions).

196. For detailed discussions of the double-dividend effect and its consequences, see IAN W.H. PARRY ET AL., WHEN CAN CARBON ABATEMENT POLICIES INCREASE WELFARE? THE FUNDAMENTAL ROLE OF DISTORTED FACTOR MARKETS (National Bureau of Econ. Research Working Paper 5967, 1997); A. Lans Bovenberg & Ruud A. de Mooij, *Environmental Levies and Distortionary Taxation*, 94 AM. ECON. REV. 1085, 1085 (1994); A.L. Bovenberg & F. van der Ploeg, *Environmental Policy, Public Finance and the Labour Market in a Second-Best World*, 55 J. PUB. ECON. 349, 350-52 (1994); Lawrence H. Goulder, *Environmental Taxation and the "Double Dividend": A Reader's Guide*, 2 INT'L TAX'N & PUB. FIN. 157 (1995); Lawrence H. Goulder et al., *Revenue-Raising Versus Other Approaches to Environmental Protection: The Critical Significance of Preexisting Tax Distortions*, 28 RAND J. ECON. 708 (1997); and Ian W.H. Parry, *Pollution Taxes and Revenue Recycling*, 29 J. ENVTL. ECON. & MGMT. S64, S65 (1995). *But see* Wallace E. Oates, *Green Taxes: Can We Protect the Environment and Improve the Tax System at the Same Time?*, 61 S. ECON. J. 915 (1995) (questioning the validity of the double-dividend argument).

revenue-recycling instrument.[197] One analysis of the U.S. SO_2 trading program, for example, estimates it to be seventy-one percent more costly because of its interactions with preexisting taxes than it would be if no such preexisting taxes were present[198] and finds that if the SO_2 trading system had sold allowances at auctions instead of issuing allowances for free (or had been an emissions tax), then the revenue-recycling effect would have recouped over half of that seventy percent additional tax-related cost.[199] A similar analysis finds that a non-revenue-recycling constraint on CO_2 emissions in the United States (i.e., allowances issued free) would impose costs several times higher than those imposed by a revenue-recycling policy (a CO_2 tax or auctioned allowances), and that whereas the revenue-recycling policy would be net beneficial, the non-revenue-recycling policy could even have negative net benefits.[200]

At the same time, recycling environmental revenues also confronts difficulties. The goals of revenue collection and pollution control may come into conflict. The revenue-maximizing tax is not the same as the externality-internalizing tax, and the two tax rates will coincide only by accident. Pollution taxes set at rates high enough to internalize social harms and discourage pollution might not maximize revenues precisely because they will discourage pollution, thereby shrinking the tax base.[201] Alternatively, pollution taxes established to maximize revenues might have to be set at a low tax rate that does not do much to reduce pollution. Hence, using pollution taxes for the very purpose of capturing the revenue-recycling benefits might lead to both persistently inadequate taxes and excessive pollution.[202] This problem is not as severe for allowance sales,

197. *See* Goulder et al., *supra* note 196, at 726-27.

198. *See id.* at 721, 726.

199. *See id.*

200. *See* LAWRENCE H. GOULDER ET AL., THE COST-EFFECTIVENESS OF ALTERNATIVE INSTRUMENTS FOR ENVIRONMENTAL PROTECTION IN A SECOND-BEST SETTING (National Bureau of Econ. Research Working Paper No. 6464, 1998). Whether net benefits are positive or negative depends on how large the marginal environmental benefits of CO_2 abatement are. A previous analysis found that the marginal abatement costs of the revenue-recycling policy start at $0, whereas the marginal abatement costs of the non-revenue-recycling policy start at $25 per ton. *See id.* at 3. Thus, for the latter to have positive net benefits, marginal benefits of abatement would have to exceed $25 per ton. The magnitude of climate protection benefits is open to much debate. *Compare* CLINE, *supra* note 9, 130-33 (finding potentially high marginal benefits), *with* WILLIAM D. NORDHAUS, MANAGING THE GLOBAL COMMONS: THE ECONOMICS OF CLIMATE CHANGE 55-59 (1994) (finding low marginal benefits).

201. *See* Arnold, *supra* note 19, at 14.

202. *See* BREYER, *supra* note 2, at 284 (suggesting that tax authorities may administer pollution taxes "with more of an eye toward increasing government revenues than protecting the environment"). In practice, most pollution tax systems have been adopted to raise revenue rather than to deter pollution. *See* Bohm & Russell, *supra* note 5, at 437. Such systems have consequently employed low tax rates that did little or nothing to diminish pollution. *See* ANDERSEN, *supra* note 118, at 8; Nathaniel O. Keohane et al., *The Choice of Regulatory Instruments in Environmental Policy*, 22 HARV. ENVTL. L. REV. 313, 314-15 & 315 n.16 (1998) (citing Richard B. Stewart, Economic Incentives for Environmental Protection: Opportunities and

because under such an instrument the quantity of emissions allowed is capped ex ante; lowering the sale price cannot increase emissions further than the total supply of allowances authorized.

Furthermore, the revenue-recycling effect may be less salient at the global level than at the national level, because there are few, if any, preexisting distortionary global taxes. To capture the double dividend, the global regulator would need to use tax revenues to reduce the internal distortionary taxes of individual nations. This would leave little revenue available for use at the global level to assist poorer societies with abatement costs. And a truly global environmental tax (or allowance sale) would raise thorny questions about who collects the revenues, who controls the use of the revenues, and by which criteria these decisions are to be made.

Third, restricting the quantity of emissions could create problems of market power. Scarcity rents are the market power to raise prices above the competitive equilibrium when output and new entrants to the industry are limited. New entrants could be impeded by a conduct instrument differentially burdening new sources, or by a quantity-based instrument capping the total amount of emissions.[203] As a result, supply of the industry's product would be limited and the price of the product would rise, reducing consumers' real net incomes.[204] In addition, the efficiency of a tradeable allowances system could be undermined if some participants exercise market power and thereby influence prices.[205] A monopolist allowance seller (or a cartel of a few powerful sellers) could seek to raise prices, or a monopsonist allowance buyer (or a cartel of a few powerful buyers) could seek to depress prices.

Fourth, taxes may be more immune to transaction costs than are tradeable allowances. Transaction costs include the costs of searching for

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Obstacles 42 (1996) (unpublished manuscript, on file with *The Yale Law Journal*)). Of course, tax authorities might also try to maximize revenues by raising tax rates above the optimal externality tax, driving down activity levels but collecting such a high tax rate on inframarginal activity that revenues increase. In either case, the revenue-maximizing tax is not (except by accident) equal to the optimal externality tax.

203. *See* James M. Buchanan & Gordon Tullock, *Polluters' Profits and Political Response: Direct Controls Versus Taxes*, 65 AM. ECON. REV. 139, 139-41 (1975).

204. *See* DON FULLERTON & GILBERT METCALF, ENVIRONMENTAL CONTROLS, SCARCITY RENTS, AND PRE-EXISTING DISTORTIONS (National Bureau of Econ. Research Working Paper No. 6091, 1997). Indeed, the prospect of earning scarcity profits suggests why existing industry members might lobby in favor of seemingly burdensome environmental regulation. *See* Buchanan & Tullock, *supra* note 203, at 146; Keohane et al., *supra* note 202, at 348-51; Michael T. Maloney & Robert E. McCormick, *A Positive Theory of Environmental Quality Regulation*, 25 J.L. & ECON. 99, 99-100 (1982). *But see* John S. Hughes et al., *The Economic Consequences of the OSHA Cotton Dust Standards: An Analysis of Stock Price Behavior*, 29 J.L. & ECON. 29, 29-31, 58-59 (1986) (reviewing the analysis by Maloney and McCormick with different data and finding no scarcity rents conferred on industry).

205. *See* Robert W. Hahn, *Market Power and Transferable Property Rights*, 99 Q.J. ECON. 753 (1984). Taxes can also be distorted by market power. *See* James M. Buchanan, *External Diseconomies, Corrective Taxes, and Market Structure*, 59 AM. ECON. REV. 174, 175 (1969).

partners, negotiating the transaction, securing regulatory approval, monitoring performance, enforcing the deal (including the costs of deterring free riding and holdouts), and insuring against nonperformance.[206] They are important in regulatory instrument choice on two dimensions.

If transaction costs between victim and source are high, liability rules are preferable to property rules. With zero transaction costs, the familiar Coase Theorem holds that the parties can costlessly reallocate entitlements to internalize externalities, regardless of the initial assignment of entitlements among them; in this case, the liability rule and the property rule are equivalent because the parties will contract around either one.[207] But if these transaction costs are high, such Coasean deals may be frustrated and externalities may persist.[208] When transaction costs are high, an initial assignment of a property rule entitlement between source and victim may be determinative and the truly efficient reallocation of the entitlement may be blocked; in such cases, the liability rule with damages set equal to harm is superior to the property rule.[209] On similar reasoning, taxes would be superior to quantity instruments under high transaction costs.[210]

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206. *See* DANIEL J. DUDEK & JONATHAN BAERT WIENER, JOINT IMPLEMENTATION, TRANSACTION COSTS, AND CLIMATE CHANGE 20-21 (OECD OECD/GD (96) 173, 1996); Coase, *supra* note 4, at 15.

207. *See* Coase, *supra* note 4, at 39-42; Kaplow & Shavell, *supra* note 5, at 733-34.

208. *See* Calabresi & Melamed, *supra* note 5, at 1094-95; Coase, *supra* note 4, at 15-19; Carl Dahlman, *The Problem of Externality*, 22 J.L. & ECON. 141 (1979).

209. *See* POSNER, *supra* note 100, at 57; Ian Ayres & Eric Talley, *Distinguishing Between Consensual and Nonconsensual Advantages of Liability Rules*, 105 YALE L.J. 235, 236-39 (1995); Calabresi & Melamed, *supra* note 5, at 1106-07; Louis Kaplow & Steven Shavell, *Do Liability Rules Facilitate Bargaining? A Reply to Ayres and Talley*, 105 YALE L.J. 221, 224, 231-33 (1995); Kaplow & Shavell, *supra* note 5, at 727. Ayres and Talley dispute Posner's claim that at low transaction costs, property rules are superior, *see* POSNER, *supra*, at 57. They argue that liability rules are universally superior to property rules, although decreasingly so as transaction costs decline, until the two types of rules are equivalent at zero transaction costs. *See* Ayres & Talley, *supra*, at 238-40.

210. It is important to recall that quantity instruments such as tradeable allowances are not pure property rule entitlements assigned to one side or the other. Tradeable allowance systems represent divided property entitlements, in which polluters get some right to emit and victims get the right to be free of emissions above the quantity limit. If the aggregate quantity of emissions entitlements is set close to the level at which the sources and victims would have agreed if they could have bargained, then tradeable allowances would not exhibit the inefficiencies of pure property rules under high transaction costs between victims and sources. This may explain why Kaplow and Shavell refer at one point to tradeable allowances as "closely related to liability rules" even though they later note that "[p]ollution taxes are essentially a form of liability rule, whereas the tradeable-rights system has property-rule-like elements." Kaplow & Shavell, *supra* note 5, at 748, 751 (citation omitted); *see also id.* at 750 n.119 (referring to "liability rules (including pollution taxes) and property rules that regulate the amount of pollution (including tradeable permit schemes)"). It is hard to classify tradeable allowances because they are not pure property rules and can be designed to behave very much like taxes. Just as taxes, unlike liability rules, do not give compensation to victims, so tradeable allowances, unlike property rules, do not give full entitlements to either side. Taxes and tradeable allowances are intermediate price- and quantity-based tools that can converge to equivalence. The clear difference between taxes and

Meanwhile, if transaction costs *among sources* are high, the cost-effectiveness of a market-based allowance trading system—which depends on trades of partial entitlements among sources—will be impaired.[211] Transaction costs in regulatory markets can be high when finding partners, monitoring performance, negotiating novel transactions for new regulatory commodities, and securing regulatory approval of trades are costly.[212] All of these costs are likely to be higher in arranging individual joint implementation projects than in participating in formal allowance trading.[213] Insurance against nonperformance can be especially costly in "informal" allowance markets, such as joint implementation, where each investor bears the full risk of project failure. In "formal" allowance markets, where investors purchase fungible partial shares of multiple and diverse abatement efforts, these insurance costs would be much lower.[214]

In contrast to these considerations favoring taxes, tradeable allowances may be superior to taxes on fairness grounds. As discussed above, taxes may impose uncompensated costs on poorer sources, whereas the initial assignment of tradeable allowances can hold poorer sources constant or even make them net gainers.[215] The relative unfairness of taxes can be removed by making redistributive payments to poorer sources that mimic the favorable initial assignment of extra allowances. But using tax revenues to make such assistance payments would deprive the tax of its revenue-recycling advantage.[216] A tax as fair as a tradeable allowance instrument may thus have only the relative advantage of better performance in the face of uncertainty.[217]

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tradeable allowances is in their performance under uncertainty about abatement costs. *See supra* Subsection III.C.3.

211. *See* Robert E. Kohn, *Transactions Costs and the Optimal Instrument and Intensity of Air Pollution Control*, 24 POL'Y SCI. 315 (1991); Robert N. Stavins, *Transaction Costs and Tradeable Permits*, 29 J. ENVTL. ECON. & MGMT. 133 (1995). On transaction costs in international environmental markets, see DUDEK & WIENER, *supra* note 206.

212. *See* DUDEK & WIENER, *supra* note 206, at 26-35 (surveying transaction costs in environmental regulatory markets); Robert W. Hahn, *Regulatory Constraints on Environmental Markets*, 42 J. PUB. ECON. 149, 171 (1990). An empirical study shows that regulatory barriers to trading can stifle environmental markets and that institutional reforms to reduce transaction costs can unleash robust trading. *See* Vivien Foster & Robert W. Hahn, *Designing More Efficient Markets: Lessons from Los Angeles Smog Control*, 38 J.L. & ECON. 19 (1995).

213. *See* DUDEK & WIENER, *supra* note 206.

214. *See id.* at 36-40, 50-51.

215. *See supra* Subsection III.C.1.

216. *See* GOULDER ET AL., *supra* note 200, at 22 ("If revenues from an emissions tax were returned as lump-sum payments rather than used to reduce pre-existing tax rates, the revenue-recycling effect would not materialize and the costs of the emissions tax in our model would be the same as those of the (non-auctioned) emissions quota.").

217. The moral criticism of incentive instruments, *see supra* Subsection III.C.1, seems to have less to say about choosing between taxes and tradeable allowances. Perhaps tradeable allowances would be preferred on moral grounds because at least they limit the total quantity of pollution, whereas taxes could conceivably allow unlimited pollution as long as sources paid their taxes. On the other hand, taxes make the polluter pay for every unit of emissions, whereas issued (nonauctioned) allowances seem to condone the polluter's initial right to pollute. In addition, taxes

D. *Summary*

Under a legal framework of Unitary Fiat, in which a hypothetical single rational decisionmaker chooses and imposes the optimal instrument directly on sources of externalities, the standard analysis suggests three basic presumptions. First, incentive instruments (taxes and tradeable allowances) are decidedly superior to conduct instruments (technology requirements) and performance standards (fixed quantity limits) in terms of cost-effectiveness and dynamic efficiency. Second, subsidies for abatement are inefficient because they perversely encourage increased aggregate activity levels by sources, potentially exacerbating total environmental damage. And third, taxes may be more efficient than tradeable allowances because of uncertainty about abatement costs, revenue-recycling (if allowances are not sold), and transaction costs.

Of course, there are numerous caveats and rejoinders; these are only presumptions. But taken together they imply that, under Unitary Fiat, global environmental taxes are the presumptive preferred regulatory instrument for addressing global environmental externalities.[218] In the contest to crown the best global environmental regulatory instrument under Unitary Fiat, the standard analysis suggests that taxes win the gold medal, tradeable allowances garner the silver, fixed emissions limits take the bronze, and subsidies and technology standards bring up the rear.

IV. CHOICE OF REGULATORY INSTRUMENTS UNDER ALTERNATIVE VOTING RULES

In contrast to instrument choice under a hypothetical single rational actor with the power of fiat, real national and global choices among regulatory instruments occur under more complex voting rules. Yet most analyses of global regulatory instrument choice take no account of this difference in voting rules across legal systems.[219] As James Buchanan has

avoid a visible market in buying and selling pollution rights, which may be what troubles moral advocates the most. *See* Arthur Hoppe, Editorial, *A License To Steal*, S.F. CHRON., Feb. 8, 1971, at 39, *reprinted in* PERSPECTIVES ON PROPERTY LAW, *supra* note 98, at 259.

218. This is the conclusion reached for control of global warming by CLINE, *supra* note 9, at 346-51, 369, 377, PIZER, *supra* note 9, at 29, Cooper, *supra* note 9, at 74-77, and Goulder et al., *supra* note 196, at 726-27. It is also the general conclusion reached as to all externality problems by Kaplow and Shavell, *supra* note 5, at 773.

219. Advocates of international GHG emissions taxes typically have not addressed whether the different voting rule in force at the global level affects the attractiveness of emissions taxes. *See, e.g.*, CLINE, *supra* note 9; PIZER, *supra* note 9; Cooper, *supra* note 9. In like fashion, advocates of internationally tradeable GHG allowances have often extrapolated from the performance of tradeable allowances at the national level, without addressing whether the different legal framework in force at the global level affects the attractiveness of tradeable allowances. *See, e.g.*, Stewart & Wiener, *Global Climate Policy*, *supra* note 11, at 106 & n.80 (citing the American SO_2 emissions trading program as a model for international GHG emissions

urged, "Economists should cease proffering policy advice as if they were employed by a benevolent despot, and they should look to the structure within which political decisions are made. . . . [We should] postulate some model of the state, of politics, before proceeding to analyze the effects of alternative policy measures."[220] This Article undertakes such an analysis of the choice of an optimal environmental regulatory instrument across different postulated models of the state. In this Part, I show that variation in the actual voting rules, taken as given,[221] significantly affects the choice of optimal regulatory instrument. In particular, this Part shows that, all other policy attributes held equal, a shift in voting rules from the coercive end of the spectrum (Fiat) toward the non-coercive end of the spectrum (Voluntary Assent) confers a distinct advantage on quantity-based tradeable allowances. Although the policy attributes discussed in Part III remain relevant to a complete analysis of the choice among regulatory instruments, this Part shows that a less coercive voting rule adds a new presumption pointing in the opposite direction from the presumptions that obtain under Fiat.

A. *The Range of Voting Rules*

Voting rules for the adoption of regulation range from Autocracy (rule by one) at one end of the spectrum (labeled point *A*) to Unanimity (rule by all) at the other end (labeled point *G*). Midway along the spectrum is Simple Majority rule (rule by fifty percent plus one). Figure 2 illustrates the spectrum.

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trading); *SO_2 Trading Program Offers Answers for Other Pollution Problems, Group Says*, 28 Env't Rep. (BNA) No. 29, at 1408-09 (Nov. 21, 1997) (reporting on an Environmental Defense Fund paper arguing that the American domestic SO_2 emissions trading program should serve as the model for international allowance trading to control global greenhouse gas emissions); William K. Stevens, *Meeting Reaches Accord To Reduce Greenhouse Gases*, N.Y. TIMES, Dec. 11, 1997, at A1 (reporting that the United States' advocacy of international tradeable emissions allowances for GHGs is "[b]ased on its [domestic] success with trading emissions of sulfur dioxide, a chemical implicated in acid rain").

220. Buchanan, *supra* note 96, at 243.

221. The condition that the voting rules are taken as given is important. *See supra* note 24. The question analyzed here is not whether the prevailing voting rules should be changed but whether regulatory instrument choice should be different at the global level because of the different voting rule at the global level. The constraints imposed by voting rules are not an artificial distortion that regulatory choice can ignore. They are just as real as the other constraints analyzed in the standard literature on instrument choice, such as transaction costs, uncertainty, and the effects of preexisting taxes. Indeed, the basic voting rule of the polity is a constitutional parameter that is likely to be far more entrenched and immutable than these other considerations. On the merits of alternative voting rules, see generally DENNIS C. MUELLER, PUBLIC CHOICE II (1989).

FIGURE 2. THE RANGE OF VOTING RULES

A	B	C	D	E	F	G
Autocracy (Fiat)			Simple Majority			Unanimity

Out of N voters, number of votes necessary to enact law:

1			(N/2)+1			N

The assumption of rational fiat in the literature on instrument choice corresponds to enlightened Autocracy, or what Buchanan labels the "benevolent despot."[222] National legislation, at least in democracies, employs a version of Majority rule,[223] which can be limited in various ways—for example, by requiring compensation to losers when the majority imposes costs via regulation.[224]

By contrast, the voting rule for international treaty law is Voluntary Assent: Treaties bind only those who consent to be bound.[225] Unlike

222. *See supra* notes 96-99 and accompanying text.

223. This is, of course, an approximation. Real national law in the United States is not simple Majority rule but often involves majority or super-majority votes in more than one legislative chamber, plus signature by the executive and review by the courts. *See* Maxwell L. Stearns, *The Misguided Renaissance of Social Choice*, 103 YALE L.J. 1219 (1994) (describing how the political system in the United States employs a combination of institutions that avoids the incapacities of simple Majority rule); *cf.* Robert C. Ellickson, *Suburban Growth Controls: An Economic and Legal Analysis*, 86 YALE L.J. 385, 404-10 (1977) (describing the Madisonian hypothesis that larger and more complex polities are better depicted by an influence model than by simple Majority rule). And regulation under real national law regularly involves negotiation and compromise with polluters, rather than simple coercion, to facilitate compliance. *See* Daniel A. Farber, *Environmental Federalism in a Global Economy*, 83 VA. L. REV. 1283, 1315 & n.161 (1997). Meanwhile, as discussed in the text, real international law is not a pure rule of Voluntary Assent but rather exhibits some coercive pressures. The differences among real legal frameworks are thus differences of degree along a spectrum.

224. *See* U.S. CONST. amend. V (stating that "private property [shall not] be taken for public use, without just compensation").

225. *See* LORD MCNAIR, THE LAW OF TREATIES 162 (1961) ("[N]o State can be bound by any treaty provision unless it has given its assent...."); SANDLER, *supra* note 56, at 12-14 (contrasting the authority to tax and regulate environmental externalities at the national level with the absence of such compulsory authority over nations at the global level); Farber, *supra* note 223, at 1314 ("The basic principle of international law, after all, is that it binds states only with their own consent."); Louis Henkin, *International Law: Politics, Values and Functions*, 216 RECUEIL DES COURS D'ACADEMIE DE DROIT INTERNATIONAL 27 (1989) ("[A] State is not subject to any external authority unless it has voluntarily consented to such authority."), *quoted in* John K. Setear, *An Iterative Perspective on Treaties: A Synthesis of International Relations Theory and International Law*, 37 HARV. INT'L L.J. 139, 158 (1996); Geoffrey Palmer, *New Ways To Make International Environmental Law*, 86 AM. J. INT'L L. 259, 272 (1992) ("The whole structure and content of treaty law is based on the principle of consent...."); Setear, *supra*, at 175-76 (noting that "a centralized authority with coercive powers... [can] produce pure public goods in a

Majority rule, Voluntary Assent cannot impose regulation on the unwilling. Voluntary Assent is slightly different from Unanimity because Voluntary Assent does not require, as Unanimity does, the consent of every last voter to become binding on those who do consent. The Voluntary Assent voting rule could theoretically appear at any point along the spectrum in Figure 2, with any number from 1 party to *N* parties consenting to adopt a regulation. But the global environmental treaty-making process, the custom of seeking consensus,[226] and the pressure to avoid the economic costs of subglobal coverage and leakage tend to place the Voluntary Assent voting rule near point *F* in Figure 2. The fundamental requirement of consent makes it analytically most similar (though not identical) to the Unanimity rule.

To be sure, the real international system does involve some coercive pressures on nation-states.[227] Nation-states respond not only to the domestic benefits and costs of joining a treaty, narrowly defined, but also to the reputational consequences of joining (esteem) or not joining (shame);[228] to domestic special interests (and transnational coalitions of such international groups) making use of nations' coercive majoritarian voting rules;[229] to forms of international law other than treaties that can, in theory, involve coercion of dissenters, such as resolutions of the U.N. Security Council,

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national economy" but that "[i]n the realm of international relations, however, no world government exists to force nations to pay taxes for pure public goods").

226. *See* HUMPHREYS, *supra* note 111, at 162.

227. *See* Martin List & Volker Rittberger, *Regime Theory and International Environmental Management*, *in* THE INTERNATIONAL POLITICS OF THE ENVIRONMENT, *supra* note 116, at 85, 108-09. List and Rittberger note that:

> [T]he spread of international environmental regimes, slow and intermittent as it may be, is part of a broader process of change in international relations. States are switching from the predominant reliance on self-help strategies to the management of interdependence through increased mutual and self-control .... Neither international ("world") government nor international anarchy are the poles towards which the collective management of international environmental problems and conflicts will direct itself. Rather, it is a changing mix of unregulated and regulated conflict management which, eventually, will give rise to "regulated anarchy" ....

Id.

228. *See* CHAYES & CHAYES, *supra* note 182, at 27; LAWRENCE E. SUSSKIND, ENVIRONMENTAL DIPLOMACY 49 (1994); Alexandre Kiss, *The Implications of Global Change for the International Legal System*, *in* ENVIRONMENTAL CHANGE AND INTERNATIONAL LAW 315, 331 (Edith Brown Weiss ed., 1992); Harold Hongju Koh, *The 1994 Roscoe Pound Lecture: Transnational Legal Process*, 75 NEB. L. REV. 181, 199 (1996); James N. Rosenau, *Global Environmental Governance: Delicate Balances, Subtle Nuances, and Multiple Challenges*, *in* INTERNATIONAL GOVERNANCE ON ENVIRONMENTAL ISSUES 19, 51-52 (Mats Rolén et al. eds., 1997).

229. *See* Robert O. Keohane & Joseph S. Nye, *Transgovernmental Relations and International Organizations*, 27 WORLD POL. 39, 43 (1974) (discussing the "[l]ack of control of sub-unit behavior by top" government leadership); Henry Lee, *Introduction* to SHAPING NATIONAL RESPONSES TO CLIMATE CHANGE 1, 14 (Henry Lee ed., 1995) (stating that "de facto transnational coalitions" often have "enormous influence" on international diplomacy); Anne-Marie Slaughter, *The Real New World Order*, FOREIGN AFF., Sept.-Oct. 1997, at 183, 184 (describing the disaggregation of the state into "separate, functionally distinct parts").

"customary international law,"[230] or outright arm-twisting via military threats or trade sanctions.[231]

But all things considered, international treaty law still remains much closer to Voluntary Assent than to the Majoritarian coercion available under national law.[232] A broad definition of national net benefit is needed to capture the multi-issue rewards to strategic decisions on individual issues in return for reciprocity on other issues. But the basic requirement of national assent based on national net benefit remains operative.[233] Large countries like China, India, Brazil, Russia, and the United States will not easily bend to coercive pressures. Notwithstanding occasional pressures on some countries to give consent against their better judgment, the basic voting rule

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230. *See, e.g.*, Statute of the International Court of Justice, June 26, 1945, art. 38(1)(b), 59 Stat. 1031, 1060, T.S. No. 993; LAKSHMAN D. GURUSWAMY ET AL., INTERNATIONAL ENVIRONMENTAL LAW AND WORLD ORDER 79-80 (1994); Birnie, *supra* note 116, at 57-61. But little or no effective international environmental law has emerged from this process, illustrating again the Voluntary Assent nature of global environmental regulation. Birnie notes that it usually takes "a considerable time for evidence to accumulate that the practice is so widely and consistently followed" that it becomes binding customary international law. Birnie, *supra* note 116, at 57. Other observers argue that customary international law has so far done little to regulate transboundary pollution. *See* Bodansky, *supra* note 117, at 117; Merrill, *supra* note 51, at 932-34, 958-67; *Developments in the Law—International Environmental Law*, *supra* note 117, at 1492-94.

231. *See* James Cameron, *The GATT and the Environment*, *in* GREENING INTERNATIONAL LAW 100, 106-16 (Philippe Sands ed., 1994); Chang, *supra* note 188, at 2131-45.

232. *See* Michael Hoel & Kerstin Schneider, *Incentives To Participate in an International Environmental Agreement*, 9 ENVTL. & RESOURCE ECON. 153, 165-67 (1997) ("When global environmental problems are at stake, no country can be forced to adhere to an internationally announced level of abatement. Only voluntary participation in an agreement is possible."). Even international law optimists affirm the central role of Voluntary Assent at the global level:

> For many . . . the absence of any central authority—the existence of anarchy between states—is the defining principle of international relations . . . . Even if this image of a Hobbesian world is rejected as overdrawn . . . , the difficulties of inter-state co-operation must still constitute the starting-point for any study of the prospects for global environmental management.

Andrew Hurrell & Benedict Kingsbury, *The International Politics of the Environment: An Introduction*, *in* THE INTERNATIONAL POLITICS OF THE ENVIRONMENT, *supra* note 116, at 1, 4-5. David Freestone—who laments that skeptics never tire of asking "is international law really law?" and who answers that to "the enduring chagrin of positivists, international law exists"—agrees that

> [t]here are major limitations in the international legal system . . . such as the sovereignty of the national state, which results in the absence of an established central legislature comparable to that existing in national systems [and] the absence of a compulsory . . . judicial system . . . .

David Freestone, *The Road from Rio: International Environmental Law After the Earth Summit*, 6 J. ENVTL. L. 193, 195 (1994). From the perspective of my analysis of alternative voting rules, international law does exist; it just starts from a voting rule quite different from that under national law.

233. *See* ROBERT O. KEOHANE, AFTER HEGEMONY 104 (1984); Robert O. Keohane, *The Demand for International Regimes*, *in* INTERNATIONAL REGIMES 141, 146-49, 152 (Stephen D. Krasner ed., 1983) (arguing that although constrained by inequalities of power and interdependence, "international regimes should not be seen as quasi-governments—imperfect attempts to institutionalize centralized authority relationships in world politics. Regimes are more like contracts . . . . In general, we expect states to join those regimes in which they expect the benefits of membership to outweigh the costs.").

for effective international environmental law remains that countries can refuse to be bound by treaties.[234]

The fundamental difference between Fiat and Majority rule on the one hand, and Voluntary Assent and Unanimity on the other, is thus the ability to coerce dissenters. Under Majority rule, the adoption of a legal rule by the requisite threshold fraction of the polity—typically fifty-one percent or perhaps a supermajority—makes it compulsory for all, including the forty-nine percent or less who objected. Under Majority rule, losing dissenters never have the option to refuse to be bound by the law.[235] Under a Voluntary Assent paradigm, dissenters cannot be coerced; rules are binding only on those who agree to be bound. International treaties are adopted by a voting rule more analogous to negotiated multiparty contracts than to national legislation.[236]

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234. That international treaty law requires the voluntary assent of sovereign nation-states is illustrated by the numerous tracts lamenting this situation and proposing that the international legal system move toward majoritarian coercion. *See, e.g.*, RICHARD A. FALK, A STUDY OF FUTURE WORLDS (1975); RICHARD A. FALK, THIS ENDANGERED PLANET: PROSPECTS AND PROPOSALS FOR HUMAN SURVIVAL (1971); HUMPHREYS, *supra* note 111, at 171; MCNAIR, *supra* note 225, at 534; WILLIAM OPHULS, ECOLOGY AND THE POLITICS OF SCARCITY 222-44 (1977); William R. Moomaw, *International Environmental Policy and the Softening of Sovereignty*, 21 FLETCHER F. WORLD AFF. 7, 14-15 (1997); Palmer, *supra* note 225, at 264; A. Dan Tarlock, *Exclusive Sovereignty Versus Sustainable Development of a Shared Resource: The Dilemma of Latin American Rainforest Management*, 32 TEX. INT'L L.J. 37 (1997). Moreover, not only is the polity's voting rule generally an exogenous "given" for any specific regulatory policy choice, *see supra* note 221, but there is a real puzzle whether the Voluntary Assent voting rule for global environmental policy in particular can ever be dislodged. In short, if the very genesis of global environmental externalities is that collective action problems prevent countries from cooperating voluntarily to protect the global environment, then it is unclear how these same countries could cooperate to establish a legal system of coercive global rules. *See* Hurrell & Kingsbury, *supra* note 232, at 7-8; James E. Krier, *The Tragedy of the Commons, Part Two*, 15 HARV. J.L. & PUB. POL'Y 325, 338 n.44 (1992); Frank I. Michelman, *Ethics, Economics, and the Law of Property*, *in* XXIV NOMOS: ETHICS, ECONOMICS, AND THE LAW 3, 30-31 (1982); *cf.* LOCAL COMMONS AND GLOBAL INTERDEPENDENCE (Robert O. Keohane & Elinor Ostrom eds., 1996) (comparing collective action problems at the local and global levels); Joseph E. Stiglitz, *On the Economic Role of the State*, *in* THE ECONOMIC ROLE OF THE STATE 56 (Arnold Heertje ed., 1989) (arguing that "the Public Good is a public good"). At the very least, it could take such a long time to establish a coercive voting rule at the global level that it would be irrelevant for addressing global environmental issues. *See* Hurrell & Kingsbury, *supra*, at 8; *see also* SPRINGER, *supra* note 114, at 51-52 ("States remain the basic units in this system, and . . . whatever erosion in their powers may be occurring is unlikely to depose them of their privileged position on the international level in a relevant time frame. . . . Any attempt to create a comprehensive framework for international environmental law must recognize this reality.").

235. Even the modified Majority rule in which losers must be compensated only amounts to a liability rule protection entitling the loser to market value for the forced expropriation, not a full property rule protection entitling the loser to refuse the exchange. *See* Fischel & Shapiro, *supra* note 102, at 276-77 (observing that the Fifth Amendment's Just Compensation Clause permits the government to force involuntary sales and thus is less protective of property rights than would be a rule that prohibited takings "*without the consent of the owner*").

236. *See* BUCHANAN & TULLOCK, *supra* note 56, at 280 (stating that a Voluntary Assent rule is equivalent to market exchange among voluntary political actors); Keohane, *supra* note 233, at 146-48 (stating that international regimes are like contracts). *But see* EVANGELOS RAFTOPOULOS, THE INADEQUACY OF THE CONTRACTUAL ANALOGY IN THE LAW OF TREATIES (1990).

The Fiat, Majority, and Voluntary Assent voting rules also differ in their costs of decisionmaking. As the number of participants who must be consulted increases, the cost of multiple negotiations and the chance that a nation will act as a holdout, insisting on satisfaction of its interests as the price for its assent, rise as well.[237] Even if all countries would reap net benefits from the treaty, uncertainty about others' likely cooperation may induce strategic noncooperation (free riding).[238] Each party's perception of its own gain in turn depends partially on its perception of whether other parties are likely to keep their end of the deal; cooperation is thus endogenous, delicate, and potentially difficult to arrange.[239] Even after becoming parties to the treaty, nation-states can withdraw or decide not to comply. Although such withdrawal or noncompliance might be made illegal under the terms of a treaty, the practical question is whether any enforceable sanctions could be brought to bear against the defector. The threat of withdrawal or noncompliance gives the nation a continuing ability to exact concessions from other parties to the treaty.[240]

Thus, although the Voluntary Assent voting rule inhibits the tyranny of the majority—the ability to coerce dissenters—it also makes the adoption of new regulations more difficult to achieve.[241] The costs to the entire group of negotiating a consensus treaty can be high in terms of the time and effort needed to craft a successful consensus, the side payments extracted by dissenters, and the collective gains forgone when individual countries delay or block action on parochial strategic grounds.[242] The Voluntary Assent

237. Richard Epstein calls the holdout under a Unanimity rule the "single pervert" who seeks to "block the state." RICHARD A. EPSTEIN, TAKINGS 333 (1985). The Voluntary Assent rule can involve lower decisionmaking costs than a Unanimity rule because under Voluntary Assent the treaty proponents need not secure the assent of every last holdout. For example, the United States did not agree to the 1997 Landmine Ban Treaty, but it was adopted by many other countries. *See* Raymond Bonner, *Land Mine Treaty Takes Final Form over U.S. Dissent*, N.Y. TIMES, Sept. 18, 1997, at A1. This could not have occurred under a Unanimity rule. Indeed, a Voluntary Assent rule can involve even lower decision costs than a Majority rule, because a treaty can involve less than 50% of all parties. But, again, the consensus rule followed at the Rio Earth Summit and other recent global environmental treaty negotiations renders the Voluntary Assent rule a close approximation of a Unanimity rule. *See* Humphreys, *supra* note 111, at 162.

238. *See* SCOTT BARRETT, A THEORY OF INTERNATIONAL COOPERATION 10-11 (Fondazione Eni Enrico Mattei Working Paper No. 43-98, 1998); W. KIP VISCUSI ET AL., ECONOMICS OF REGULATION AND ANTITRUST 737-40 (1995); Hurrell & Kingsbury, *supra* note 232, at 5.

239. *See* Todd Sandler & Keith Sargent, *Management of Transnational Commons: Coordination, Publicness, and Treaty Formation*, 71 LAND ECON. 145, 146-51 (1995).

240. Put another way, the challenge of deterring free riding encompasses the deterrence of subsequent noncompliance as well. *See* BARRETT, *supra* note 238, at 20-26.

241. *See generally* BUCHANAN & TULLOCK, *supra* note 56, at 63-91 (illustrating the tradeoff between the costs of coercion and the costs of decisionmaking as the voting rule changes).

242. I have not mentioned a well-known source of high decisionmaking costs under Majority rule, the problem of indeterminate vote-cycling identified by Condorcet and Arrow. First, the Condorcet-Arrow theory of majority-vote cycling is subject to much debate: Although simple models of Majority rule depict endless cycling, real Majority rule exhibits considerable stability. *See* MUELLER, *supra* note 221, at 58-95; Stearns, *supra* note 223; Gordon Tullock, *Why So Much Stability?*, 37 PUBLIC CHOICE 189 (1981). Second, cycling problems may apply to Voluntary

voting rule does avoid the special decisionmaking problem under absolute Unanimity that the very last strategic holdout can extort large concessions and delays from the would-be cooperators. Under Voluntary Assent, decisionmaking costs will be less than under Unanimity to the extent that some (small) number of holdouts can be ignored by the cooperating group. But if "leakage" of sources of the global externality is important, there will be powerful incentives for countries to seek nearly universal assent.[243]

B. *Participation Efficiency*

The Voluntary Assent rule in operation at the global level creates quite different conditions for regulatory instrument choice from those obtaining under Fiat. Under Voluntary Assent, participation by sources of the externality must be attracted rather than compelled. Attracting participation at least cost—what I term "participation efficiency"—becomes as important as cost-effectiveness, incentives for innovation, performance under uncertainty, revenue-recycling, and the other attributes that make up the standard analysis reviewed in Part III. In this Section, I show that tradeable allowances are likely to be decidedly more participation-efficient than subsidies, taxes, and other instruments.

Assent voting as well, at least as long as the number of assenting participants is not fixed (as it would be under a strict unanimity rule) but can grow or shrink as the candidate rule to be adopted changes. Third, to the extent that vote cycling is actually more of a problem under Majority rule than under the Voluntary Assent rule, this only suggests that both voting rules have high decisionmaking costs. This does not help much in distinguishing among the available regulatory instruments.

By contrast, the ability to coerce dissenters is a sharp difference between the two voting rules with direct implications for the choice among regulatory instruments. At least for this purpose, coercion is a far more important attribute of Majority rule than is cycling. "[T]he central problem for democratic theory is not that we cannot figure out what majorities want, but that when we give majorities what they want, we may have some very upset minorities!" Bernard Grofman, *Public Choice, Civic Republicanism, and American Politics: Perspectives of a "Reasonable Choice" Modeler*, 71 TEX. L. REV. 1541, 1587 n.210 (1993).

243. A corollary of the lower decisionmaking costs facing government under Majority rule than under Voluntary Assent is that government institutions will tend to be larger and more powerful under Majority rule than under Voluntary Assent. The ability under Majority rule to tax the population, to require information disclosure, and to enact statutes and issue regulations, even over the objections of dissenters, gives Majority rule a greater capacity to fund and equip an administrative bureaucracy. *See* JAMES BUCHANAN & RICHARD E. WAGNER, DEMOCRACY IN DEFICIT (1977); Robert D. Tollison, *Public Choice and Legislation*, 74 VA. L. REV. 339, 364-66 (1988). A more unitary implementation structure may also facilitate a more potent administrative state. *See* GEOFFREY BRENNAN & JAMES M. BUCHANAN, THE POWER TO TAX: ANALYTICAL FOUNDATIONS OF A FISCAL CONSTITUTION 33 (1980) (stating that interjurisdictional competition restrains expansionary tendencies of central governments).

1. *From Kaldor-Hicks to Pareto-Improving*

Under Fiat or Majority rule, conduct rules, taxes, and quantity limits can be imposed on sources without the sources' consent. As noted above, under Fiat, the rational regulatory decisionmaker's efficiency criterion would be Kaldor-Hicks: Aggregate benefits must exceed aggregate costs, so that winners gain enough to be able to compensate losers, but such compensation to losers need not actually occur.[244] This is the basis on which economists conventionally discuss instrument choice.[245] Under simple Majority rule, a policy could be adopted as long as the gains exceeded the losses sufficiently to garner one more than half the votes.[246] The key point is that, whether the Fiat and Majority rules actually achieve net social gains or not, they can and typically do coercively impose uncompensated costs on the dissenters. As Buchanan and Tullock have noted, "the essence of the collective-choice process under majority voting rules is the fact that the minority of voters are forced to accede to actions which they cannot prevent and for which they cannot claim compensation for damages resulting."[247]

By contrast, under the Voluntary Assent voting rule, regulation cannot be imposed on sources without the sources' consent. Regulation therefore requires achieving Pareto improvement among participants, which means that as some are made better off, no one is made worse off.[248] Under Voluntary Assent, international regulation of global externalities must be Pareto-improving. It must be an arrangement that "in fact, makes all parties better off. Otherwise, any agreement is unlikely.... Such policies must

244. *See* BAUMOL & OATES, *supra* note 3, at 96 n.4; POSNER, *supra* note 100, at 13-15.

245. *See* POSNER, *supra* note 100, at 14.

246. If all interests were effectively and equally represented in the voting body, Majority rule would correspond to Kaldor-Hicks efficiency. *See* Gary S. Becker, *A Theory of Competition Among Pressure Groups for Political Influence*, 98 Q.J. ECON. 371, 383-84 (1983) (theorizing that competition among interest groups fosters Kaldor-Hicks efficiency because it increases the likelihood that the least inefficient regulations will be adopted). If all interests are not effectively and equally represented in real majoritarian rule—because, among other things, of the transaction costs of exercising political voice—then real Majority rule may adopt policies that benefit politically active groups to the net detriment of society and that therefore do not satisfy even Kaldor-Hicks efficiency. *See* MUELLER, *supra* note 221, at 244-45; MANCUR OLSON, THE RISE AND DECLINE OF NATIONS 41-47 (1982); Douglass C. North, *A Transaction Cost Theory of Politics*, 2 J. THEORETICAL POL. 355, 362-63 (1990); *see also* Robert W. Hahn, *Economic Prescriptions for Environmental Problems: Not Exactly What the Doctor Ordered*, *in* THE POLITICAL ECONOMY OF GOVERNMENT REGULATION 131, 173-77 (Jason F. Shogren ed., 1989) (doubting Becker's hypothesis in light of the empirical evidence of inefficient instrument choice in U.S. environmental regulation).

247. BUCHANAN & TULLOCK, *supra* note 56, at 89-90.

248. *See id.* at 92 (stating that the Pareto criterion is strictly satisfied "only if all persons agree, that is, only if there is the unanimous consent of all members of the group"); *id.* at 95 ("All less-than-unanimity decision-making rules can be expected to lead to nonoptimal decisions by the Pareto criterion."). Richard Posner notes that Pareto improvement requires that any adversely affected parties must be "actually compensated." POSNER, *supra* note 100, at 14. Posner also notes that "the criterion of Pareto superiority is unanimity of all affected persons," *id.* at 13, or "something that only a voluntary transaction can create," *id.* at 14.

constitute a Pareto improvement for all nations concerned."[249] An international environmental treaty must be not only collectively attractive (improving net global well-being), but individually attractive to every signatory (improving each country's net well-being). No party will agree to the regulatory regime unless it reaps net gains from joining (or at least is made no worse off).[250] A party may reap net gains directly from the shared protective effects of the environmental policy. Or it may receive net gains by being compensated via side payments from the direct beneficiaries.[251] If a regulation would impose net costs on a party, those net costs must *actually* be compensated to attract that party's assent.[252]

The Voluntary Assent rule means that global regulatory treaties are cooperation games. A chief obstacle to cooperation is that, for each player, free riding on others' efforts may be preferable to acting alone, even though mutual effort would be collectively preferable to mutual inaction.[253] The

249. BAUMOL & OATES, *supra* note 3, at 279; *see also* SANDLER, *supra* note 56, at 14 ("Successful collective action [to address global problems] requires that all participants receive a net benefit. This simple realization is often forgotten."); Carlo Carraro & Domenico Sinscalco, *The International Protection of the Environment: Voluntary Agreements Among Sovereign Countries*, *in* THE ECONOMICS OF TRANSNATIONAL COMMONS, *supra* note 81, at 192, 197 ("The minimum requirement [for an international environmental treaty] is that the welfare of *each* country signing the co-operative agreement be larger than its welfare under no cooperation." (emphasis added)).

250. *See* Keohane, *supra* note 233, at 147, 152, 167; Detlef Sprinz & Tapani Vaahtoranta, *The Interest-Based Explanation of International Environmental Policy*, 48 INT'L ORG. 77, 80-81 (1994). Gains and losses need not be defined rigidly here. Parties' gains could include, for example, net income, improved reputation, esteem for being a leader, improved environmental quality, the value of altruistic contributions, and other factors. Losses could include net payments, impaired reputation, shame for being recalcitrant, diminished environmental quality, and other factors.

251. *See* BUCHANAN & TULLOCK, *supra* note 56, at 90-91. Buchanan and Tullock note that "[t]he unanimity test is, in fact, identical to the compensation test if compensation is interpreted as that payment . . . which is required to secure agreement [to the policy]." *Id.* at 91.

252. Strictly speaking, the Voluntary Assent rule differs from a full Unanimity rule as to the costs imposed on dissenters (nonparticipants). The Unanimity rule ensures zero real uncompensated costs to anyone because a policy cannot be adopted unless it obtains the assent of all affected persons. The Voluntary Assent rule can yield real uncompensated costs to nonparticipants because there can be a treaty imposing external costs on those that do not ratify. *See* Keohane, *supra* note 233, at 152. For example, industrialized countries could agree to a treaty to restrict GHG emissions, benefiting the signatories but imposing uncompensated costs on nonsignatory countries that would benefit from a warmer world. Such costs are analogous to the externalities imposed on nonparticipants by voluntary private market transactions that do not involve all affected persons. Still, the "consensus" rule followed at the Rio Earth Summit and other major environmental treaty negotiations renders the Voluntary Assent rule a close approximation to a Unanimity rule. *See* HUMPHREYS, *supra* note 111, at 162.

Moreover, to attract assent a treaty need only make each signatory net better off compared to that party's *not joining* the treaty, *not* compared to there being *no treaty at all*. A country could rationally assent to a treaty given that others are going to assent—because being left out would be worse than joining—even though the *best* result for that party would be no participation by *any* country. Thus, the requisite side payment need only cover the dissenter's marginal costs of joining, not its total costs of the treaty's occurring. I am grateful to Jim Hammitt and Scott Barrett for discussion of this point.

253. In a standard two-player cooperation game, often called a "prisoner's dilemma," the benefits of cooperation are shared reciprocally by cooperators. To illustrate, assume the benefits

challenge of global environmental regulation in such cases is thus to create institutions that raise the benefits of collective action, raise the costs of free riding, raise players' confidence that others will cooperate rather than free ride, and reduce the costs of collective action.[254] Although much attention has been focused on the procooperative influence of strategies such as repeat playing, communication, and credible threats against free riders, there is also a large role for the choice of regulatory instruments to play in overcoming free riding. Regulatory instruments can help overcome free riding if they raise the benefits of collective action or reduce the costs of collective action.[255] Regulatory tools that are more costly to implement or promise fewer collective benefits can exacerbate free riding and hence be self-defeating.[256]

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of cooperation by each player are 8, the benefits of noncooperation are 0, and the costs of cooperation (abatement of the externality) by each player are 5. If both cooperate, each gains 8 at a cost of 5, for a net of 3 each. If neither cooperates, each gains 0 and loses 0. If one cooperates while the other defects, they share the nonexclusive benefit of 8 for a gain of 4 each, but the defector enjoys a net gain of 4 while the sole cooperator pays the cost of 5 for a net gain of -1. The choice matrix shows each player's net outcome:

	If Player B:	
If Player A:	Cooperates	Defects
Cooperates	A: 3, B: 3	A: -1, B: 4
Defects	A: 4, B: -1	A: 0, B: 0

Each player's preference ordering is *DC* > *CC* > *DD* > *CD* (where *C* denotes "cooperate" and *D* denotes "defect," and the first letter in each pair denotes the player's own behavior while the second letter in each pair denotes the other player's behavior). In the example above, *DC* = 4, *CC* = 3, *DD* = 0, and *CD* = -1. If the other player cooperates, defecting yields the higher reward (4 > 3); and if the other player defects, defecting again yields the higher reward (0 > -1). The result is that both players defect and fail to abate, *DD*. This occurs even though their combined result, if they could agree on mutual cooperation (CC = 3+3 = 6), would be preferable to mutual defection (*DD* = 0 + 0). Indeed, the collective preference ordering is *CC* > (*DC* = *CD*) > *DD* (here, 6 > 3 > 0). *See* MUELLER, *supra* note 221, at 9-12; Aronson, *supra* note 11, at 2150 & n.38.

254. *See* AXELROD, *supra* note 58, at 124-51 (identifying strategies to promote cooperation); Barrett, *supra* note 58, at 275-82 (applying cooperation-promoting strategies to international environment agreements). The same applies to all collective action problems, not just global cooperation. The establishment of legal regimes to manage local resources that had previously been treated as open-access can be viewed as a problem of creating institutional arrangements that yield gains from cooperation exceeding the costs of cooperation. *See* Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 347-48, 350, 350-57 (1967); Robert O. Keohane & Elinor Ostrom, *Introduction* to LOCAL COMMONS AND GLOBAL INTERDEPENDENCE, *supra* note 234, at 1-4, 13-15, 22-23.

255. For example, if the cost of cooperation (abatement) by each party in the example *supra* note 253 were only 2 instead of 5, then for each player *CC* = 6, *DC* = 4, *CD* = 2, *DD* = 0. In this case, *CC* > *DC* > *CD* > *DD* for each player. The reduced cost of abatement makes cooperation the attractive strategy for both players, regardless of the other player's choice. The result is *CC*, the collective optimum outcome.

256. Note that there might also be first movers, for whom the preference ordering would be *CC* > *CD* > *DC* > *DD*. These players are sources who would rather have mutual cooperation but who would still act in the absence of cooperation because they perceive gains to acting first. For example, they might believe the Porter hypothesis that first movers in regulation will gain a technological edge over later movers. *See* Michael E. Porter & Claas van der Linde, *Toward a New Conception of the Environment-Competitiveness Relationship*, 9 J. ECON. PERSP. 97 (1995); Michael E. Porter, *America's Green Strategy*, SCI. AM., Apr. 1991, at 168. For criticism of the

In addition to free riding by potential net beneficiaries of mutual cooperation, a second obstacle to international successful regulation is recalcitrance by potential net losers. Recall Figure 1. Those in Group *V* (the pure victims of the global externality) are obviously especially keen to promote global action to limit sources. The other two groups (*S* and *S&V*) involve sources that will have to bear some costs if the global environment is to be protected. Cooperation by members of Group *S&V* (reciprocal sources/victims) is easier to achieve than cooperation by Group *S* (pure sources) because the reciprocal source countries also stand to gain from collective regulation.[257] Nonbeneficiary sources (Group *S*) do not gain from collective regulation. They bear net costs. (In addition, some countries in Group *S&V* may also bear net costs if their benefits of cooperative abatement are less than their costs of cooperation.) These "cooperative losers" in Group *S* (and some in Group *S&V*) are worse off if they participate in the regulatory regime than if they do not.[258] An extreme

Porter hypothesis, see Adam B. Jaffe et al., *Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?*, 33 J. ECON. LITERATURE 132 (1995); Karen Palmer et al., *Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?*, 9 J. ECON. PERSP. 119 (1995); and Noah Walley & Bradley Whitehead, *It's Not Easy Being Green*, HARV. BUS. REV., May-June 1994, at 46. *Cf.* Richard A. Clarke, *The Challenge of Going Green*, HARV. BUS. REV., July-Aug. 1994, at 37 (involving 12 experts debating Porter and his critics). Whether or not the Porter hypothesis is valid, if some players believe in it they could face a first mover preference ordering and hence engage in abatement, even if others do not. First movers might also be motivated by a strong belief in exercising leadership for its own sake, by a very "green" electorate, or by other factors. Several European countries, including Germany and the Netherlands, seem to be acting as first movers on climate protection, aggressively limiting their GHG emissions. The United States was a first mover on stratospheric ozone protection, limiting CFC emissions by unilaterally banning the use of CFCs on aerosol spray cans in 1978. *See* Hammitt & Thompson, *supra* note 29.

257. *See* BAUMOL & OATES, *supra* note 3, at 279; Barrett, *supra* note 85, at 70, 72 ("A country has no incentive to abate its emissions if the externality is unidirectional (provided side payments are ruled out) . . . . Not so if the externality is reciprocal in nature. For then the emitting country will have strong private incentives to control its own emissions.").

258. *See* Aronson, *supra* note 11, at 2150-51; Merrill, *supra* note 51, at 974-75, 981, 1017-18. The cooperative loser has a preference ordering of *DC* > *DD* > *CC* > *CD*. This preference ordering makes cooperation even more elusive in the "cooperative loser" game than in the "prisoner's dilemma" game. *See* Aronson, *supra* note 11, at 2151 n.44 (explaining the distinction between prisoner's dilemma and cooperator's loss). Thus, the cooperative loser prefers total noncooperation (*DD*) to mutual cooperation (*CC*). This is in contrast to the free rider, whose preference ordering is *DC* > *CC* > *DD* > *CD* and who prefers mutual cooperation (*CC*) to total noncooperation (*DD*). *See id.* The Cooperative Loser is worse off with cooperative abatement because the cooperative loser's costs exceed her benefits even if others cooperate. For example, if mutual cooperation gives Player *A* benefits of 14 at a cost of 8, while giving Player *B* benefits of 4 at a cost of 6; if cooperation by one party alone yields half the benefits to each (i.e., 7 for *A*, 2 for *B*); and if defection costs 0; then the matrix shows:

	If Player B:	
If Player A:	Cooperates	Defects
Cooperates	A: 6, B: -2	A: -1, B: 2
Defects	A: 7, B: -4	A: 0, B: 0

example is the group of countries that perceives a gain from the global environmental externality—for example, countries that would welcome a warmer planet.[259] These countries would oppose cooperation by others.[260] Whereas free riders are potential net beneficiaries who would cooperate if confident that others will reciprocate, "cooperative losers" must receive additional compensatory side payments to secure their participation.[261]

2. *Benefits and Costs of Securing Participation*

The Voluntary Assent rule thus introduces a new attribute that is not relevant under Fiat and that is less relevant under Majority rule: "participation efficiency." Participation efficiency is the ability of a regulatory instrument to secure participation at the least cost. All other attributes being equal, the optimal regulatory instrument will minimize the sum of the costs of securing participation and the costs of enduring nonparticipation (i.e., the forgone benefits of participation).

To begin with the latter item, the benefits of securing participation include: (i) more effective control of globally dispersed sources; (ii) reduced leakage; (iii) a wider set of abatement opportunities, implying lower marginal costs of abatement; and (iv) reduced free riding as others increasingly cooperate reciprocally. Reducing leakage is particularly important because, with globally mobile sources and globally spread impacts regardless of the sources' location, leakage can offset or reverse the

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The preference ordering for *A* is $DC = 7$, $CC = 6$, $DD = 0$, $CD = -1$, that is, $DC > CC > DD > CD$, reflecting the prisoner's dilemma incentives to free ride unless the other party will cooperate. The preference ordering for *B* is $DC = 2$, $DD = 0$, $CC = -2$, $CD = -4$, that is, $DC > DD > CC > CD$, reflecting a cooperative loss: *B* would rather have mutual defection (*DD*) than mutual cooperation (*CC*). *See* Aronson, *supra* note 11, at 2155-56 & fig.3. The collective preference ordering is $CC = 4$, $DC = 3$, $CD = 1$, $DD = 0$, so mutual cooperation is the global optimum. To persuade *B* to find *CC* preferable to *DD*, Player *A* would need to transfer to *B* just more than 2, say 2.1, so that for *A*, $CC = 3.9$ and for *B*, $CC = 0.1$. *See id.* at 2156-57 & fig.4. Then for both *A* and *B* the preference ordering would be $DC > CC > DD > CD$, so that both would prefer mutual cooperation to mutual defection, as in the prisoner's dilemma game, and cooperation could succeed if free riding were deterred.

259. *See supra* note 81 and accompanying text.

260. *See* SANDLER, *supra* note 56, at 114 ("The possibility [exists] that some nations may gain from global warming .... Potential gainers will resist any international treaty on global warming.").

261. [A] noncooperative strategy always dominates for the [non-beneficiary] source state: failure to agree upon a regime of regulation corresponds to a victory for the source state .... Joint social welfare may be maximized by collective action, but the [non-beneficiary] source state stands only to lose from participating in such a regime. Thus, [a non-beneficiary source state] will refuse to cooperate unless some other benefit or advantage of greater value can be linked to its agreement to participate in a collective action regime.

Merrill, *supra* note 51, at 981; *see also id.* at 934-35, 1017 (noting that a source state has no incentive to participate in a regulatory regime unless it receives compensation).

environmental benefits of the regime.[262] In addition, leakage increases the externality-intensiveness of the initially unconstrained group, making it increasingly difficult over time to attract unconstrained parties to join the constraint group.[263] Finally, leakage raises the specter of competitiveness losses in the constraint group, which increases the ex ante incentives to free ride.[264] Thus, securing widespread participation (especially by present and future large emitters) can be a prerequisite to the success of global environmental law. Reducing marginal abatement costs through wider participation (especially by developing countries) is also a prerequisite to obtaining the estimated fifty to seventy percent cost-effectiveness gains of global incentive instruments.[265]

The costs of securing participation include: (i) the out-of-pocket expense of making side payments; and (ii) the costs of foregone policy stringency or other modifications to the regulatory regime that are the price of attracting participation. Further, they include (iii) the distortionary costs of the method used to secure participation.[265]

In principle, participation efficiency can be just as important as the more conventionally analyzed attributes of instrument choice, such as cost-effectiveness, performance under uncertainty, and revenue recycling. If an instrument has very low participation efficiency, it may fail to secure

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262. *See supra* Section II.B.

263. *See* Schmalensee, *supra* note 75.

264. *See supra* note 72 and accompanying text.

265. *See supra* Subsection III.C.1.

266. It may be useful to contrast these three kinds of participation costs to Professor Michelman's famous classification of the costs associated with takings of private property. *See* Frank I. Michelman, *Property, Utility, and Fairness: Comments on the Ethical Foundations of 'Just Compensation' Law*, 80 HARV. L. REV. 1165, 1214-16 (1967); *see also* Fischel & Shapiro, *supra* note 102, at 277-86 (explicating Michelman's model). Michelman takes the case of a government action being imposed by a state with coercive power (Fiat or Majority rule), thereby creating some losers, and asks whether the state nevertheless ought to pay compensation to the losers. Michelman labels the costs of compensating the losers "settlement costs" and the costs of not compensating the losers "demoralization costs." He argues that the state should pay the losers if demoralization costs exceed settlement costs—that is, if the costs of not paying exceed the costs of paying (assuming that the government action is Kaldor-Hicks efficient, i.e., retains social net benefits after paying the losers). But it should not pay if settlement costs exceed demoralization costs. *See* Michelman, *supra*, at 1214-16.

Under the Voluntary Assent voting rule, the power to coerce the losers is lacking. In this case, uncompensated losers do not suffer "demoralization costs" from the government action; instead, they simply avoid these costs by declining to be regulated. The costs of not compensating losers under the Voluntary Assent rule are therefore "costs of nonparticipation" rather than demoralization costs. As one moves along the spectrum in Figure 2 toward decreasingly coercive voting rules—from Fiat to Unanimity—the costs of not compensating losers will shift from demoralization costs (falling with decreasing coercion) to nonparticipation costs (rising with decreasing coercion).

Meanwhile, Michelman's "settlement costs" are analogous to my "costs of securing participation." Notably, as Fischel and Shapiro clarify, these costs of paying losers include not only the out-of-pocket side payment, but also the moral hazard problems thereby created that may perversely induce increased risk-making. *See id.* at 284-85. On moral hazard created by international side payments, see *infra* Subsections IV.B.4 and IV.B.5.

widespread participation—entailing all the environmental and economic disadvantages of partial coverage and leakage—or it may secure participation only at such a high cost that the direct benefits of the environmental regulatory regime are erased or outweighed by the social and environmental costs of the inefficient method for securing participation.

Participation can be a function of instrument choice, because different policy designs create different costs and benefits for different actors and for the group as a whole. Game theoretic approaches that treat participation as binary—either cooperate or not, with a stipulated net payoff for cooperation—obscure the fact that the choice of the instrument to be adopted via cooperation can also affect the payoff schedule.[267] In the standard cooperation game—a prisoner's dilemma—the choice of instrument can facilitate cooperation by reducing the costs of participation. Thus, cost-effective instruments such as taxes and tradeable allowances can be more participation-efficient than high-cost conduct (technology) rules or fixed quantity limits. The cost-effective instruments enlarge the zone for mutually agreeable contracts (i.e., voluntary assent to treaties).[268] In the more difficult game involving a "cooperative loser," the choice of instrument must be compatible with participation-efficient side payments. If China and Russia perceive costs to limiting fossil fuel emissions and benefits to agriculture from allowing warming to occur,[269] they would demand compensatory side payments as the price of assenting to global GHG emissions regulation. Or, in the effort to protect global biodiversity against deforestation, a country like Brazil might demand side payments if it sees itself as a cooperative loser that would bear major domestic costs but share only a fraction of the global gains.[270]

If global environmental protection is a normal economic good with a long time-horizon, poorer countries with more immediate local priorities and high demand for industrialization are especially likely to be important sources and cooperative losers under global environmental regulatory

267. *Cf.* Barrett, *supra* note 58, at 277 (criticizing as "caricature" analysis that portrays choices as binary and arguing that most choices are continuous).

268. *See* KEOHANE, *supra* note 233, at 83-84 (arguing that international law can succeed in constraining state behavior under the Voluntary Assent rule, through the creation of institutions that lower the costs of collective cooperation); Robert Axelrod & Robert O. Keohane, *Achieving Cooperation Under Anarchy: Strategies and Institutions*, *in* COOPERATION UNDER ANARCHY 226, 249-50 (Kenneth A. Oye ed., 1986).

269. *See supra* note 81.

270. *See* HUMPHREYS, *supra* note 111, at 163 ("[I]f there is to be a [global forest convention] it is clear that the developing countries will expect economic concessions from the developed countries."); SANDLER, *supra* note 56, at 95-97 (arguing that industrialized countries must pay to conserve forests for their global environmental value); Stone, *supra* note 55, at 613-26 (noting that biodiversity conservation will require industrialized countries to pay developing countries). *See generally* TIMOTHY M. SWANSON, THE INTERNATIONAL REGULATION OF EXTINCTION (1994) (stating that protecting global biodiversity will require that industrialized countries pay developing countries to conserve species habitats).

regimes.[271] If these players do not participate, given their large and growing share of global GHG emissions and forest loss, an international regime to limit GHGs or deforestation would be practically futile. It would also be much more costly, because the opportunities for low-cost abatement in those countries would be missed. Worse, under a regime not covering China, Russia, India, or Brazil, leakage of emissions-intensive and forest-clearing activities might have net perverse effects if the emissions or biodiversity losses per unit of economic activity were higher in those countries than they would have been in the participating countries. Such leakage would also make the nonparticipating countries even larger sources over time and hence even less likely to agree to cooperate. And the prospect of leakage of employment opportunities could undermine ex ante incentives of industrialized countries to act. Thus, the participation inefficiencies of omitting major cooperative losers from global environmental regulation could be easily large enough to wipe out or even reverse the net benefits of such a regime. On the other hand, if side payments to these countries are structured in ways that invite moral hazard and other distortions, the participation inefficiencies of *including* major cooperative losers in global environmental regulation could also be daunting. Maximizing participation efficiency under Voluntary Assent by minimizing the sum of the costs of nonparticipation and the costs of securing participation requires careful selection of regulatory instruments and associated side payments.

3. *From "Polluters Pay" to "Beneficiaries Pay"*

The greatest challenge in global environmental law may not be overcoming free riding among the industrialized countries (surmounting the perennial spats among the United States, Europe, and Japan over who will exercise leadership), but rather securing the participation of the developing countries (such as China, Brazil, Russia, and India). On this analysis, a North-South bargain is needed not only for reasons of distributional equity, but also to secure participation in an efficient global regime that delivers valuable net benefits to the North, without putting the South in the recalcitrant position of cooperative loser. Like any bargain, this deal could be mutually beneficial if the cooperative losers received compensation that made them net better off while not costing so much that the cooperative winners' net environmental benefits were eliminated. As the IPCC noted, "International transfers . . . are likely to serve as both the building blocks of globally optimal action and the cement of global cooperation."[272]

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271. *See supra* Section II.C.

272. K.J. Arrow et al., *Decision-Making Frameworks for Addressing Climate Change*, *in* IPCC ECON. 1995, *supra* note 6, at 53, 71; *see also* Stavins, *supra* note 6, at 298 (stating that because in some countries, "costs of control may exceed benefits," a "central challenge for any

Most of the discussion of global regulatory instrument choice has ignored this point. It has proceeded as if a global instrument could be imposed by Fiat or Majority vote on all sources. Proposals for global GHG emissions taxes or agreements to undertake globally coordinated national taxes[273] collide with the problem that cooperative loser countries will decline to participate. The same is true of global conduct instruments, such as mandatory CO_2 scrubbers or fuel efficiency standards, and of fixed national quantity limits. Each of these instruments would impose costs on sources, only exacerbating the cooperator's loss problem.[274] Under the Voluntary Assent voting rule, the conventional instruments for regulating externalities cannot cover cooperative losers. If major sources are cooperative losers (which is quite plausible since major sources—especially poorer industrializing countries such as China—would often face greater costs than gains from control), the conventional instruments employed under Unitary Fiat are, instead, a recipe for widespread nonparticipation.

Perhaps the proponents of global taxes and conduct instruments are implicitly willing to tolerate the costs of nonparticipation (including leakage) inherent in leaving major countries out of the regime. Or perhaps they fear high costs of securing participation. Or perhaps they are not considering the impact of the global voting rule on regulatory instrument choice. If so, they may be thinking about regulatory instrument choice from the standard analytic perspective of rational autocratic Fiat, or from the

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international policy instrument" is to "include a mechanism for transferring gains to countries that would otherwise not benefit from joining an agreement").

273. *See* sources cited *supra* note 9.

274. *See* Aronson, *supra* note 11, at 2161-62. Similarly, a price/liability instrument administered judicially—that is, strict liability—confronts the same obstacle that, under Voluntary Assent, many sources will simply decline to be bound by such a regime. *See* Merrill, *supra* note 51, at 974-75, 992-97. Merrill's critique of strict liability for international pollution is thus a special case of my more general argument that cost-imposing regulatory instruments will be participation-inefficient under the Voluntary Assent voting rule. Advocates of taxes might reply that if countries could retain the tax revenues themselves under a coordinated set of national GHG taxes (rather than paying taxes to an international body), countries might perceive net gains from the revenue-recycling effect of the GHG taxes and would therefore participate. But such GHG taxes would still impose economic costs on each country due to internal shifts in investment patterns. *See* MABEY ET AL., *supra* note 70, at 32. The revenue-recycling studies still show net costs from GHG taxes. *See, e.g.*, GOULDER ET AL., *supra* note 200, at 20-21 (finding revenue-recycling taxes to be 35% more costly than ideal taxes). For a country gaining low or negative net benefits from reducing global warming, these tax costs likely would be more than enough to motivate nonparticipation. Otherwise, the logic must be that countries gaining nothing from global warming abatement (zero global externality reduction) would still like to tax their GHG emissions, as long as their trade rivals do too. This reduces to an argument that gaining purely domestic benefits (such as local environmental or fiscal recycling benefits) through GHG taxes would be worthwhile to each country but is obstructed by a "race-to-the-bottom" prisoner's dilemma. For a criticism of this rationale for imposing overarching standards, see generally Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race-to-the-Bottom" Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. REV. 1210 (1992).

perspective of national Majority rule, either of which can compel participation by dissenters.[275]

Under Fiat, the standard conclusion is that taxes are the superior instrument. But under Voluntary Assent, taxes may be the *least* participation-efficient and therefore potentially the lowest ranking instrument. This is because taxes impose the highest costs on sources and will therefore induce the greatest rate of nonparticipation under Voluntary Assent. Whereas fixed quantity targets and conduct instruments impose the cost of abatement on sources, taxes (or allowance auctions) oblige the source to pay not only the cost of abatement but also the additional cost of the tax rate applied to all the source's remaining emissions.[276] Under Voluntary Assent, a global GHG tax or coordinated set of national taxes (or an allowance auction) will attract the least participation by cooperative loser countries.

A clear implication of this analysis is that the "Polluters Pay Principle" cannot succeed under the Voluntary Assent rule. Under such a voting rule, polluters will simply decline to participate in a regime that imposes net costs on them. Trying to establish such a regime will encounter stalemate. The "Polluter-Pays-Principle is . . . inconsistent with our insistence [under a voluntary assent rule] on a Pareto-improvement. . . . In fact, the Polluter-Pays-Principle is more likely to constitute reason for delay and evasion than for an effective program to control transnational pollution."[277]

Under the Voluntary Assent voting rule, regulatory instruments must instead follow a "Beneficiaries Pay Principle." The beneficiaries of global environmental protection must attract non-beneficiary sources to participate, because the former cannot compel the latter to comply under Voluntary Assent.[278] This is the converse of the standard approach in

275. In one paper, Richard Cooper does acknowledge the importance of securing the assent of nations for global environmental regulation to be successful. *See* Hollick & Cooper, *supra* note 81, at 170. But Cooper does not follow the logic to the need for side payments to potential cooperative losers such as China and Russia, nor does he compare the ability of taxes and allowance trading to secure such nations' assent. *See* Cooper, *supra* note 9; Hollick & Cooper, *supra* note 81.

276. *See* BREYER, *supra* note 2, at 281; Bohm & Russell, *supra* note 5, at 417-18; Buchanan & Tullock, *supra* note 203, at 139-41.

277. BAUMOL & OATES, *supra* note 3, at 281, 283; *see also* MABEY ET AL., *supra* note 70, at 11-12 (noting that international cooperation "contradicts the [Polluters Pay Principle]," which depends upon "coercion"); Aronson, *supra* note 11, at 2150-51 (noting that there is no incentive to cooperate if a country's costs of abatement exceed its gains); d'Arge & Kneese, *supra* note 54, at 441, 449 (noting that the "Polluter Pays Principle" is not workable in the global context); Merrill, *supra* note 51, at 974-75, 980-81, 1017-18 (arguing that placing burdens on source states removes incentives for cooperation).

278. *See* BAUMOL & OATES, *supra* note 3, at 281 ("Mutual gains to the countries necessarily require the victim country . . . to make some payments to [the source country]."); *id.* at 283 ("[I]t is our judgment that feasible and effective mechanisms for the control of transnational pollution will require cooperation and cost-sharing on the part of victim nations as well as polluting countries."); Merrill, *supra* note 51, at 935 ("Thus, the source state has no incentive to participate . . . unless it receives compensation of some sort from the affected state.").

national regulatory law. In the national context, we customarily think of forcing sources of externalities to internalize the external costs of their activities. But when the sources can *choose* whether to internalize their externalities, they might often choose not to do so. Our conventional notions of pollution regulation are built on the crucial unstated premise that Fiat or Majority rule enables sources to be compelled to participate. Under the Voluntary Assent rule, this coercive power is missing, and instrument choice must be differently conceived. Instead of forcing the source to pay for the external costs of its activities, the beneficiaries must pay for the external benefits of restricting the source's activities.[279]

Beneficiaries will want to make such side payments as long as the marginal dollar of side payment yields more than one dollar of benefits in externality control.[280] Sources will demand side payments of no less than the net losses imposed on the source country by the control regime. The smaller the source country's benefits and the larger its costs under the regime, the larger the compensatory side payment must be to render the global regime a net benefit for this country.[281]

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279. It is now widely agreed that wealthy countries will have to pay poorer countries to persuade them to engage in global environmental protection efforts. *See, e.g.*, DANIEL C. ESTY, GREENING THE GATT: TRADE, ENVIRONMENT, AND THE FUTURE 84-85 (1994); HAHN, *supra* note 83, at 31 ("[D]eveloping countries have no incentive to sign an agreement now unless the developed countries foot the bill . . . ."); THOMAS C. SCHELLING, COSTS AND BENEFITS OF GREENHOUSE GAS REDUCTION 14 (1998) ("And if we want to keep the Chinese from letting their emissions grow . . . . in the short run—that is, within twenty-five years—we have to pay for it."); Arrow et al., *supra* note 272, at 71; Jacoby et al., *supra* note 76, at 60 ("[I]f the relatively rich participating countries want to stabilize atmospheric concentrations of greenhouse gases, they will have to pay at least some poor countries to reduce their emissions."); Bruce M. Russett & John D. Sullivan, *Collective Goods and International Organization*, 25 INT'L ORG. 845, 863-65 (1971) (arguing that because international law lacks coercive power, international environmental protection will often require rich nations to pay poor nations' costs); Stone, *supra* note 55, at 613.

This notion is not new. Pigou envisioned both charging pollution taxes and paying bounties to polluters in return for reduced emissions. *See* PIGOU, *supra* note 3, at 192-95. Calabresi and Melamed showed that a court might want to impose the Victims Pay Principle in some situations. *See* Calabresi & Melamed, *supra* note 5, at 1116-21; *cf.* Spur Indus. v. Del E. Webb Dev., 494 P.2d 700 (Ariz. 1972) (ordering victims to pay a feedlot for the cost of abating a nuisance). There may, of course, be important wealth effects and fairness consequences involved in the Victims Pay Principle. Calabresi and Melamed suggest that with poorer polluters and wealthier victims—an assumption that seems apt in the global environmental context—the Victims Pay Principle is more fair than the Polluters Pay Principle. *See* Calabresi & Melamed, *supra* note 5, at 1121.

280. Hence, beneficiaries will only want to offer side payments to countries that would otherwise be important sources of the externality. A cooperative loser that is not an important source, such as a country that gains agriculturally from global warming but emits few or no GHGs, would be unlikely to attract side payments from beneficiaries. This point illustrates again an important difference between the Voluntary Assent voting rule and a strict Unanimity voting rule: Under the latter, every holdout would have to be paid to assent, lest the entire regime fail, whereas under the former, less important sources would be neglected.

281. The point is not limited to climate change policy. A treaty taxing Brazil for the damage that Amazon deforestation does to global biodiversity and global climate would require some way to compel compliance by Brazil. Under the Voluntary Assent rule, without such coercion, Brazil would demur. The beneficiaries of biodiversity protection and climate protection—presumably the

In general, the greater the fraction of voters needed to adopt a regulatory instrument, or, in other words, the less coercive the voting rule (moving to the right on the spectrum in Figure 2), the more participation efficiency matters in selecting among regulatory instruments. Between the assumption of full coverage under single-decisionmaker Fiat at one end of the spectrum, and the imperative of securing participation under Unanimity or Voluntary Assent toward the other, lies the intermediate case of Majority rule. Inducements to cooperate are needed under Majority rule to build the majority coalition and to mollify potential blocking coalitions. Securing adoption of legislation under Majority rule may therefore require some compensatory side payments from beneficiaries to losers, if those losers' consent is important to facilitate passage of the legislation by the requisite majority. That such majority coalition politics help shape environmental regulation is widely observed.[282] The 1990 Clean Air Act amendments, for example, involved numerous deals to compensate potential opponents in order to assure adoption of the legislation.[283] By contrast, the coercive majoritarian imposition of bans on hazardous waste disposal (without side

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wealthier countries—would have to pay Brazil to secure its assent to conserve the Amazon. *See* sources cited *supra* note 270. The experience of the Montreal Protocol is illustrative. China and India initially refused to join the Protocol. Presumably they saw it as imposing on them the costs of CFC control—including the public health risks of food spoilage, hunger, and food-borne disease from which inexpensive refrigeration with CFCs could deliver their poorer populations—and providing them only lesser and more distant gains. *See* Jonathan Baert Wiener, *Protecting the Global Environment*, *in* RISK VS. RISK 193, 197-98 (J. Graham & J.B. Wiener eds., 1998). China and India joined the Protocol only when they were promised financial compensation by the beneficiary countries. *See* Harold K. Jacobson & Edith Brown Weiss, *Compliance with International Environmental Accords: Achievements and Strategies*, *in* INTERNATIONAL GOVERNANCE ON ENVIRONMENTAL ISSUES 78, 95 (Mats Rolen et al. eds., 1997) ("India and China would not become parties to the Montreal Protocol until the agreement about compensatory financing had been reached at the London meeting in 1990.").

282. *See* BRUCE A. ACKERMAN & WILLIAM T. HASSLER, CLEAN COAL / DIRTY AIR 42-58 (1981); E. Donald Elliott, Bruce A. Ackerman, & John C. Millian, *Toward a Theory of Statutory Evolution: The Federalization of Environmental Law*, 1 J.L. ECON. & ORG. 313, 316-17 (1985); Daniel A. Farber, *Politics and Procedure in Environmental Law*, 8 J.L. ECON. & ORG. 59, 60-61 (1992); Keohane et al., *supra* note 202, at 325-26; Roger G. Noll, *Economic Perspectives on the Politics of Regulation*, *in* 2 HANDBOOK OF INDUSTRIAL ORGANIZATION, *supra* note 103, at 1253; Donald N. Dewees, *Instrument Choice in Environmental Policy*, 21 ECON. INQUIRY 53, 53 ("[I]f we are to understand why policies are not adopted and to develop policy designs that may be both efficient *and* politically attractive, we must analyze the essence of political decisions: the distributional effects of policies." (emphasis added)); Robert W. Hahn, *The Political Economy of Environmental Regulation: Towards a Unifying Framework*, PUB. CHOICE, Apr. 1990, at 21, 23-24.

283. *See* Robert Glicksman & Christopher H. Schroeder, *EPA and the Courts: Twenty Years of Law and Politics*, 54 LAW & CONTEMP. PROBS., 249, 285-86 (1991) (reciting special favors incorporated in the 1990 Clean Air Act Amendments); Heinzerling, *supra* note 151, at 328-32 (describing the allocation of extra SO_2 allowances in the 1990 Clean Air Act Amendments). *But see* Paul L. Joskow & Richard Schmalensee, *The Political Economy of Market-Based Environmental Policy: The U.S. Acid Rain Program*, 41 J. L. & ECON. 37, 80-81 (1998) (finding the mix of burdens and favors in the acid rain program of the 1990 Clean Air Act Amendments to be quite complex, with most high-emitting states doing well in Phase I of the program but several high-emitting states doing poorly in Phase II).

payments to the waste disposal industry) has resulted in widespread "nonparticipation costs" manifested by illegal dumping;[284] side payments to encourage proper disposal could be more effective.[285] Side payments may also be necessary where regulations are adopted by consensual mechanisms such as "regulatory negotiation"[286] and neighbors' restrictive covenants.[287] The "Beneficiaries Pay Principle" is far more important under Voluntary Assent than under Majority rule because under Majority rule a majority coalition can ultimately coerce a dissenting minority, whereas under Voluntary Assent every loser must be paid to play.

4. *The Participation Efficiency of Regulatory Instruments*

Under the Voluntary Assent rule, then, collective regulation must be regulation guided by the Beneficiaries Pay Principle. Much of this payment may be accomplished directly by the environmental benefits of the treaty itself, but for some important sources these direct benefits will be inadequate to motivate participation, and side payments will be necessary. Not all regulatory instruments, however, accomplish the beneficiaries pay arrangement in the same way. As Merrill notes: "The principal problem is how to devise the means of providing offsetting compensation to the source state as consideration for its agreement to cooperate in a contractual solution."[288] The problem is to choose the regulatory instrument that secures participation at the least cost.

a. *Carrots (Subsidies)*

The most straightforward strategy to achieve the Beneficiaries Pay Principle would be to offer nonbeneficiary source countries (cooperative losers) a pure payment to cover their cost of abatement.[289] But making

284. *See* Hilary Sigman, *Midnight Dumping, Public Policies, and Illegal Dumping of Used Oil*, 29 RAND J. ECON. 157, 157-78 (1993).

285. *See id.* at 175-76.

286. *See* Negotiated Rulemaking Act, 5 U.S.C. §§ 561-70 (1994); Philip Harter, *Negotiating Regulations: A Cure for Malaise*, 71 GEO. L.J. 1 (1982); Lawrence Susskind & Gerard McMahon, *The Theory and Practice of Negotiated Rulemaking*, 3 YALE J. ON REG. 133 (1985).

287. *See* Robert C. Ellickson, *Cities and Homeowners Associations*, 130 U. PA. L. REV. 1519, 1533-39 (1982); Richard A. Epstein, *Covenants and Constitutions*, 73 CORNELL L. REV. 906 (1988).

288. Merrill, *supra* note 51, at 1018. Merrill poses the question but does not answer it; instead, he argues that strict liability impedes such contractual solutions and that a set of "golden rules" of behavior could at least do better than strict liability. *See id.* at 1018-19. But Merrill's "golden rules" would still not compensate source states for their cooperation.

289. *See* BAUMOL & OATES, *supra* note 3, at 279-81 (discussing direct payments from victim to sources); CLINE, *supra* note 9, at 356 ("[I]mportant emitters could still refuse to cooperate. The first and most desirable response to this situation would be to proffer the positive incentive of international assistance . . . ."); Stone, *supra* note 55, at 613, 619-20 (advocating direct payments for biodiversity conservation). Direct financial assistance through centralized funds could perform

actual payments to enlist the cooperation of nonbeneficiary sources is essentially a subsidy for abatement, and in like fashion it creates moral hazard—the perverse incentive for increased emissions or resource use that is the basic problem with both domestic[290] and international pollution abatement subsidies.[291] The subsidy for abatement—paying the source's costs of externality control—induces recipients to increase their risk-making activities. It improves the profitability of the externality-associated activity and thereby encourages entry into the global polluting industry group.[292] In effect, the side payment reintroduces the problem of "leakage": Even though the source country is now participating in the treaty, the side payment relieves the source of the costs of abatement while abatement costs are imposed on sources in other countries. Compounding these effects on aggregate industry output is the strategic incentive for countries that would actually be cooperative winners to posture as cooperative losers in order to position themselves to demand side payments by increasing their emissions or resource use.[293]

Taken together, these perverse incentives can be quite potent. A recent study of climate protection regimes under the Voluntary Assent voting rule, with and without side payments for participation, found that "side payments . . . reduce the incentive to join an agreement . . . . [initially and] might not even be desirable from an environmental point of view, because they might decrease the degree of cooperation sufficiently to result in higher total emissions."[294] A treaty meant to prevent global warming or

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this role. Joint implementation, or payments through the Clean Development Mechanism created under the Kyoto Protocol, if delivered without any constraint on aggregate emissions in recipient countries, would also resemble a pure subsidy for abatement.

290. *See* BAUMOL & OATES, *supra* note 3, at 211-13, 234; *supra* Subsection III.C.2.

291. *See* BAUMOL & OATES, *supra* note 3, at 281; Chang, *supra* note 188, at 2154-59.

292. *See supra* Subsection III.C.2.

293. *See* d'Arge & Kneese, *supra* note 54, at 428, 436-37 (noting that the Victims Pay Principle has a "basic flaw" in that "the externality-generating country may threaten . . . to discharge materials as an incidental aspect of the production of other goods simply to obtain compensation for not doing so"); *cf.* David A. Koplow & Philip G. Schrag, *Carrying a Big Carrot: Linking Multilateral Disarmament and Development Assistance*, 91 COLUM. L. REV. 993, 1026-42 (1991) (proposing that wealthy countries use development aid to pay for the global public good of disarmament by poorer countries such as the former Soviet Union); *id.* at 1041 (warning that such payments could "become counterproductive in the long run by instituting a perverse incentive to 'build up to build down'" (citation omitted)).

294. Hoel & Schneider, *supra* note 232, at 165. Hoel and Schneider's quantitative model for one illustrative case suggests that offering side payments for emissions abatement results in *fewer* countries participating in the regime without earning side payments (that is, more countries insisting on side payments as a condition of participation) and in *higher* total emissions than does a similar regime that does not offer such side payments—even though some countries would not participate at all in abatement if side payments were not offered. *See id.* at 164-67. That is, the perverse incentives are so strong that they overwhelm the environmental benefits of attracting more countries to limit emissions. Note that Hoel and Schneider's Table 1, *id.* at 166 tbl.1, and the characterization of the number of countries participating, must be interpreted with care, because Hoel and Schneider define "participating" to mean reducing emissions without receiving side payments even if side payments are offered, *see id.* at 167 n.2. Thus, the trivially low number of

biodiversity loss could turn out not to remedy these problems as much as intended, or even to worsen them.

Joint Implementation and Clean Development Mechanism (JI/CDM) investments in uncapped countries could amount to unconstrained subsidies for abatement. Sources in capped countries would be paying the abatement costs of sources in uncapped areas. If so, JI/CDM could have the perverse consequences of pure subsidies. Instead of being a stepping stone to formal allowance trading under a global cap, JI/CDM could unintentionally turn out to increase aggregate emissions by attracting greater investment into the emitting industries in recipient countries. Without national caps, there would be no constraint preventing the emitting industries receiving JI/CDM payments from growing overall. Project-level baselines and monitoring would not reveal the aggregate dynamic. Given the imminence of JI/CDM trades "for credit," this possibility deserves prompt quantitative assessment. If it is serious, JI/CDM credits should be discounted accordingly, and the transition to full formal allowance trading under global caps should be pressed even more urgently (as described below).

b. *Sticks (Trade Sanctions)*

Instead of being subsidized, participation could be coerced. Holdouts could be shamed into joining the treaty or threatened with trade sanctions. In effect, free riders and cooperative losers would be induced to cooperate not by promises of compensatory side payments to make these countries net better off, but rather by threats that non-cooperation would invite even higher net costs than would cooperation.[295]

A coercive strategy might be superior to a pure subsidy strategy because the latter introduces perverse incentive effects and thus has high costs of securing participation.[296] But coercive strategies also pose high

countries listed as participating when side payments are offered—three out of 100 in the last line of Table 1—means that only three countries reduced emissions without requiring a side payment, but the countries that did receive side payments also reduced emissions. The more salient and troubling result is Table 2b, showing total emissions increasing when side payments are offered. *See id.* at 166 tbl.2b. Note also that Hoel and Schneider do not include any "cooperative losers" in their model; all countries are taken to be cooperative gainers with positive environmental benefits. *See id.* at 153, 156. The three who participate without requiring side payments are thus close to "first movers," and the others are free riders. This limitation of their model probably understates the emissions-control benefits of offering side payments and thus overstates the perverse effect on total emissions of offering side payments, because cooperative losers would never reduce emissions without compensation, whereas free-riding cooperative gainers might do so. These limitations also suggest the need for further modeling of climate protection regimes with different forms of side payments, different regulatory instruments, and different combinations of national net benefits.

295. *See* BARRETT, *supra* note 238, at 25-26; Barrett, *supra* note 58, at 280-82.

296. *See supra* Subsections III.C.2, IV.B.4.a; *see also* Sean Fox, Note, *Responding to Climate Change: The Case for Unilateral Trade Measures To Protect the Global Atmosphere*, 84

costs. Compared to a Pareto-improving regulatory regime that avoids the perverse incentive effect, there are several reasons to think that coercive measures would be undesirable.

First, coercion may not be effective in changing the behavior of target countries. Trade sanctions may make little impact on target countries' policies, or they may counterproductively hurt the target country's population (especially its lower-income population) while shoring up the target government's relative power against its domestic opponents and even giving aid to its efforts to rally patriotic fervor in defiance of the sanctions.[297] Trade sanctions seem especially unlikely to change the basic development ambitions and economic policies of large countries like China, Russia, Brazil, and India.[298]

Second, threats of coercion may not be credible. Trade sanctions impose costs on the country adopting the trade barrier as well as on the target country. It is hard to imagine the industrialized countries imposing trade sanctions on goods from China that would be sufficiently restrictive to coerce China into substantial GHG abatement, because such trade sanctions against a major exporting country would carry high costs to consumers in the industrialized countries.[299]

Third, trade sanctions can distort trade and thus impair global economic efficiency. Their imposition may even spur retaliation, opening a destructive trade war.[300] But because global environmental externalities also

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GEO. L.J. 2499 (1996) (advocating trade sanctions); *cf.* Chang, *supra* note 188, at 2154-60 (preferring trade sanction "sticks" to side payment "carrots").

297. *See* Richard N. Haass, *Sanctioning Madness*, FOREIGN AFF., Nov.-Dec. 1997, at 74, 77-80.

298. Advocates of trade sanctions might respond that sanctions should be just as effective as subsidies. Why should the trade penalty needed to internalize the global cost of a unit of emissions not be equal to the subsidy payment required to internalize the global benefit of abatement of that unit of emissions (and thus to motivate the same degree of abatement effort)? One answer is that the coercive trade penalty may evoke defiant opposition, muting its incentive effect. Resentful defiance may be especially intense when the penalty is sought to be imposed on an ostensibly sovereign nation by ostensibly coequal nations. By contrast, subsidies, or a cooperative regulatory regime with side payments, would not spur such defiance. And trade sanctions imposed laterally by coequal sovereign nations are quite different from taxes imposed top-down by a superior governmental authority recognized to have the legitimate power to regulate its citizens coercively for the collective good; such taxes can be expected to evoke less (though obviously not zero) defiance. Analogously, a child may accept parental discipline but bridle at the same sanctions imposed by a sibling. Put another way, whereas top-down coercive regulation may force the regulated population to endure "demoralization" costs, *see* Michelman, *supra* note 266, at 1214, attempts at lateral coercive regulation by nation against nation, from a starting point of Voluntary Assent and in the absence of a central state enforcement mechanism, may motivate the targets of the coercion to avoid demoralization costs via noncompliance. The evidence, marshaled by Sigman, *supra* note 284, that coercive sanctions on hazardous waste disposal yield perverse noncompliance—even when imposed within a strong majoritarian state—suggests that this result would be even more likely in the international arena without strong central monitoring and enforcement.

299. *See* Aronson, *supra* note 11, at 2160 & n.94; Barrett, *supra* note 58, at 281-82 (finding some trade sanctions to enforce global environmental protection not to be credible).

300. *See* Chang, *supra* note 188, at 2162-63.

represent a market failure, the question is whether trade restrictions help more than they hurt,[301] compared to other available regulatory instruments.

Fourth, where they do influence target countries' behavior, coercive trade sanctions may perversely inhibit environmental compliance by target countries. As compared to side payments that enrich an erstwhile dissenter, trade sanctions to induce compliance would injure a dissenter until it agrees to comply. If financial and institutional capacity is an important constraint on countries' actual compliance, then side payments may accelerate compliance whereas further weakening of a poor dissenter through trade sanctions may impede its ability to comply effectively once it grudgingly decides to accede to the treaty.[302] Given that cooperative losers are more likely to be poorer countries (because lower-income countries value global environmental protection less highly) and that poverty itself is likely to be a prime cause of some contributions to global externalities (such as forest clearing), coercive trade sanctions that further impoverish erstwhile dissenters could be seriously counterproductive.

Fifth, trade sanctions imposed by wealthy countries on poor countries would cut sharply against principles of fairness. Because poorer countries tend to see global environmental protection as a low priority compared to more pressing needs for eradicating poverty,[303] coercing their compliance with a global environmental regulatory regime would be regressive, transferring wealth from the worst off to the more wealthy. It would also conflict with principles of self-determination only recently secured by developing countries emancipated from colonial rule.[304] Clearly, such a strategy would not be globally Pareto-improving. Moreover, the perception of this unfairness may further undermine the enthusiasm that poor countries bring to the job of eventual compliance.[305]

Thus, trade sanctions cannot guarantee effective participation and attempting to use them could be costly. The mere threat of inchoate trade sanctions may be useful for nudging free riders into action.[306] But actual coercion of cooperative losers, especially poorer countries, is a different story. The use of coercive measures to corral poor cooperative losers is less attractive than the use of an appropriately designed Pareto-improving

301. *See id.* at 2201.

302. *See* GRACIELA CHICHILNISKY, DEVELOPMENT AND GLOBAL FINANCE: THE CASE FOR AN INTERNATIONAL BANK FOR ENVIRONMENTAL SETTLEMENTS 16 (U.N. Dev. Program Office of Dev. Studies Discussion Paper No. 10, 1997) (arguing that global policies burdening poor countries could yield more environmental degradation); Jacobson & Weiss, *supra* note 281, at 109 (making a similar argument).

303. *See supra* Section II.C.

304. *See* Hurrell & Kingsbury, *supra* note 234, at 7-8.

305. *See* Jacobson & Weiss, *supra* note 281, at 95.

306. *See* Barrett, *supra* note 58, at 280-82 (showing that the threat of trade sanctions can bind free riders).

regime.[307] Coercive trade sanctions on poor source countries could well be ineffective, non-credible, unfair, distorting of global trade, and ultimately destructive of poor countries' capacity to help solve the environmental problem.

c. *Taxes*

A straightforward global environmental tax is a Polluters Pay instrument that would confront high costs of nonparticipation. Many countries would decline to be bound. An alternative approach would be to design a regime employing a global tax to limit emissions or resource use, and then to add side payments to attract cooperative losers. This approach would impose a global tax on sources and match the tax with a set of international side payments that would assure individual net benefits to those who would be cooperative losers under the tax.[308] This amounts to Polluters Pay plus side payments, or a "tax-and-pay" approach.[309]

This strategy has the superficial attraction of suppressing emissions through the tax. But the nonbeneficiary source country will not assent unless its net costs of compliance with the tax—including both its cost of abatement *and* its cost of paying the tax on its residual emissions (net of any environmental or other benefits)—are at least covered by the side payment. The side payment will therefore have to be proportionately larger under the tax-and-pay approach than under the pure payment approach. Furthermore, the side payment will have to be proportionate to the taxed country's total emissions. The influence of the tax on emissions will therefore be vitiated by the need to repay the costs of the tax: At the margin, the nonbeneficiary source country will have to be paid back for every additional dollar of abatement cost or tax obligation it incurs. Precisely because a tax instrument *does not constrain total emissions*—it only

307. Baumol and Oates conclude that:

> [Such a set of tariffs] is a desirable policy measure only if a more direct attack on the problem [via a global regulatory agreement] is not possible. . . . [But b]ecause the record of international cooperation on other critical matters hardly inspires confidence in the prospects for efficacious multilateral measures for the protection of the environment, it may be essential to design instruments whose effectiveness does not require the unanimous consent of those involved.

BAUMOL & OATES, *supra* note 3, at 276.

308. *See* CLINE, *supra* note 9, at 377 ("Some portion of revenue from carbon taxes should be channeled to developing countries prepared to take measures limiting [emissions].").

309. It is worth noting that this tax-and-pay strategy would mean using a potentially large fraction of the tax revenues for side payments to the cooperative losers, rather than recycling the revenues to offset preexisting distortionary taxes. The logic of the Voluntary Assent voting rule greatly inhibits or precludes domestic revenue-recycling of global externality taxes. Hence, taxes and nonauctioned tradeable allowances are more equivalent under the Voluntary Assent voting rule.

constrains the maximum marginal cost of abatement[310]—the side payment reimbursing the cost of the tax will undercut the ability of the tax to inhibit emissions in the recipient country.[311]

Consider the depiction in Figure 3. Assume two countries: one a pure source (*S*) and the other a pure victim (*V*). The horizontal axis shows emissions increasing from left to right, so that abatement involves moving back from current emissions at point *C* toward zero emissions at the origin. In this depiction, abatement is all cost to *S* and all benefit to *V*.[312] In this simple example, *V* would prefer zero emissions, which assures zero damages to *V*. But that would not be globally optimal because it ignores the cost to *S*. Indeed, globally optimal abatement would be at the point (*P*, *Q*). But reducing emissions from *C* to *Q* is all pain and no gain to *S*.

Under Fiat and the Polluters Pay Principle, *S* could simply be required (or taxed) to abate for the collective benefit of the society (i.e., *S* and *V*), up to the globally optimal point (*P*, *Q*). This is the familiar standard analysis. If *S* abates its emissions from *C* to *Q*, it incurs the abatement cost represented by the area *CEQ*. *V* gains (in damages avoided) the area *CZEQ*. The collective global net gain is the area *CZE*.

Under Voluntary Assent, however, *S* will refuse to abate without compensation. *S* will decline to adopt a treaty setting a global tax (or set of coordinated national taxes) at *P*, or setting a global quantity limit at *Q*, because these treaties impose cost on *S* for no gain to *S*. In order to get *S* to

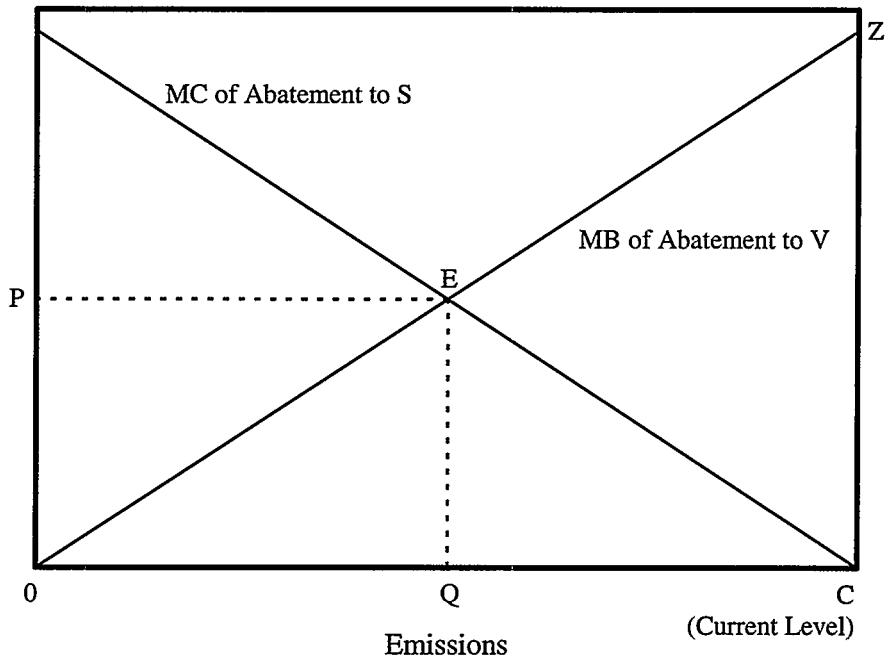
310. This is the basis for the advantage of taxes over quantity limits under uncertainty: Taxes fix the upper-bound of abatement costs but do not fix the level of abatement. *See supra* Subsection III.C.3. The very advantage of taxes over allowances in the face of cost uncertainty (and Fiat) turns out to be the tax instrument's chief weakness under the Voluntary Assent voting rule.

311. This inefficiency of the tax-and-pay approach is analogous to the more familiar inefficiency of paying compensation to polluters for the costs of "regulatory takings." Promising compensation for environmental regulatory takings of land can give rise to moral hazard (excessive risk-making) by landowners and perversely attract greater investment into the regulated industry, thereby offsetting or possibly even overwhelming the protective effect of the regulation. *See* Lawrence Blume et al., *The Taking of Land: When Should Compensation Be Paid?*, 99 Q.J. ECON. 71, 82-84 (1984); Fischel & Shapiro, *supra* note 102, at 284-85; Louis Kaplow, *An Economic Analysis of Legal Transitions*, 99 HARV. L. REV. 509, 528-31 (1986); Louis Kaplow, *Government Relief for Risk Associated with Government Action*, 94 SCANDINAVIAN J. ECON. 525, 528-29 (1992). This literature on regulatory takings advances the proposition that compensation should not be paid. By contrast, compensation is unavoidable (or else high costs of nonparticipation must be tolerated) under the Voluntary Assent voting rule, so the question is how best to pay compensation while suppressing its perverse incentives. Given the requirement for compensation in the U.S. Constitution, the analysis in this Article of how to pay compensation while suppressing its perverse incentives could be useful at the domestic level as well.

312. *V* is a zero-emitting "beneficiary" of abatement and *S* is a zero-beneficiary source. This is "unidirectional" transboundary pollution, not a reciprocal global externality, but it illustrates the problem at the limit. Reciprocal global externalities involve a less extreme case of the same problem—that is, one in which both *V* and *S* are both victims and sources, but to different degrees, so that abatement yields net gains in *V* and net costs in *S*. *V* is then a beneficiary source—a cooperative winner—and S is a non-beneficiary source—a cooperative loser.

agree to the abatement treaty, *V* must pay *S* an amount no less than the cost imposed on *S*.[313]

FIGURE 3. ABATEMENT OF GLOBAL EXTERNALITIES



Under the pure payment approach, *V* must pay *S* an amount at least equal to *S*'s cost of abating down to *Q*, which is the triangular area *CEQ*—the area under *S*'s marginal cost curve as emissions are reduced from *C* to *Q*. This subsidy of *CEQ* will initially reduce emissions in *S*. But as a subsidy, it will also increase the profitability of operating an emissions source in *S* compared to other uses of capital and thus will induce an increase in the size of the emitting industry in *S* and attract more countries to emit.[314] Moreover, the prospect of such side payments may also induce strategic posturing by countries who increase their emissions to look like cooperative losers and hence to attract side payments. The composite effect is to offset the subsidy's efficacy in reducing global emissions, or even to yield a net increase in emissions.

313. In the more general case in which *S* is also a partial victim and *V* is also a partial source, *S* will still demur whenever the treaty imposes net cost on *S*, and *V* will have to pay *S* an amount no less than the net cost imposed by the treaty on *S*.

314. *See supra* Subsections III.C.2, IV.B.4.a; *cf.* BAUMOL & OATES, *supra* note 3, at 218-24 (explaining this outcome in a domestic competitive industry context).

If a global tax of P is imposed, S incurs the cost of abating down to Q (the triangular area CEQ). In addition, S also incurs the cost of paying the tax on all its residual emissions below Q (the rectangular area $OPEQ$). These are the emissions for which S's marginal cost of abatement exceeds P, so that S would rather pay the tax on these remaining emissions than abate further. To get S to assent to this tax, V must now pay S a sum at least equal to both S's cost of abatement down to Q (the area CEQ), plus S's tax obligation for all residual emissions below Q (the area $OPEQ$).[315] The tax reduces emissions from taxed firms in S. But the side payment repays the tax dollar for dollar and thus vitiates the effect of the tax in S, letting S's emissions rise again.[316] The same problems of strategic posturing arise as well.[317]

Thus, the uncompensated Polluters Pay approaches (conduct instruments, taxes, or quantity limits, so long as imposed without side payments) are participation-inefficient because they have high costs of nonparticipation. The pure subsidy approach (including direct aid and uncapped financing through joint implementation and the Clean Development Mechanism) is participation-inefficient because it has high costs of securing participation. It induces perverse behavior that can worsen the very environmental problem that the regulatory regime was meant to abate. And even the tax-and-pay approach is participation-inefficient because it must offset the incentive effect of the tax with compensatory side payments that at least undercut the corrective effect of the tax and possibly even worsen overall environmental quality.

d. *Tradeable Allowances*

By contrast, quantity-based instruments offer a way to engage participation while suppressing the perverse incentives of subsidies. The essential feature of a quantity instrument is that it caps the total quantity of emissions. A quantity-based instrument plus side payment—a "cap-and-pay" strategy—can attract participation without inducing a perverse

315. This may not be worthwhile for V if the area $CZEQ$ is smaller than the area $OCEP$—i.e., if V's gain is less than S's cost of abatement plus the cost of residual taxes.

316. If the side payment could be lump-sum, it would not directly influence S's marginal cost of emitting and would not directly induce S to increase emissions. But it is difficult to see how the side payment could be lump sum because it must vary proportionately with S's emissions, abatement costs, and residual tax obligation on unabated emissions. The higher S's cost of abatement and residual tax cost, the more V must pay S to abate. *Cf.* Hanson & Logue, *supra* note 14, at 1275 (noting that taxing smokers and rebating the tax ex ante, in order to make smokers no worse off, would vitiate the incentive effect of the tax).

317. The side payment from V does not act as a tax in V that reduces emissions in V because by assumption there are no emissions sources in V. Even if there were sources in V, the side payment would not act as an extra tax on sources in V because it responds to the quantity of emissions in S, not to emissions in V.

influence on the total level of emissions. Thus, a cap-and-pay strategy can be more participation-efficient than the pure payment, the tax alone, the cap alone, or the tax-and-pay strategy.[318]

In Figure 3, if a global limit of Q emissions is imposed, S incurs the cost of abating down to Q (the area CEQ). (If the quantity allowance is sold to S at the price P instead of issued to S for free, then S also incurs the cost of purchasing the remaining emissions units up to Q, that is, the area $OPEQ$, just as under the global tax.) To get S to abate, V must pay S at least all of this cost. This is the same wealth transfer to S as under the pure payment (or the tax-and-pay strategy, if S must purchase the allowance). But now there is a key difference. The quantity limit prevents emissions in S from rising above Q. The perverse effect on emissions is avoided. (Some ex ante posturing might still occur as countries seek to win side payments.)[319]

Several variations on the cap-and-pay strategy are possible. The cap-and-pay instrument could employ fixed quantity targets coupled with a financial reward for participation. This is the approach taken in the Montreal Protocol,[320] which limits each country's quantity of CFC consumption and also provides financial aid to secure the participation of key developing countries through the Montreal Protocol Multilateral Fund paid for by the beneficiary countries.[321] This approach puts a lid on the perverse effect that side payments can have on the total level of the externality. But fixed quantity targets do not attain the cost-effectiveness advantages of tradeable allowances. That means higher global costs, and it also means lower incentives for cooperative winners to cooperate in the first place.

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318. After criticizing subsidies for their perverse incentives, Professor Robert Kohn notes:

> An alternative approach that combines the political feasibility of subsidy, the economic efficiency of the Pigouvian tax, and requires no cash payments by the government, is the assignment to existing polluters of an efficient quantity of transferable discharge permits. This policy approach . . . is a quasi-subsidy because the freely given permits can be sold by their recipients. It appears that economists' continuing interest in subsidizing pollution abatement and their interest in transferable discharge permits may usefully coalesce.

Kohn, *supra* note 187, at 86.

319. From this perspective, the perverse inefficiencies of compensating for regulatory takings, *see supra* note 311, are able to arise because the regulation itself acts as a conduct requirement or tax on the risky activity and does not impose a national quantity cap on the risky activity. Conduct requirements and taxes do not limit the quantity of risk-making, so the compensation payment can perversely increase investment in risk-making. If the regulation were a national quantity cap, then compensation for the regulatory taking would not attract more investment to the risky activity because investors would be constrained by the quantity cap. This suggests that quantity caps may be a possible route to more efficient regulation given the compensation requirement of the Fifth Amendment of the U.S. Constitution.

320. Montreal Protocol, *supra* note 34.

321. *See* Jacobson & Weiss, *supra* note 281, at 95.

A second cap-and-pay instrument would employ tradeable allowances, coupled with a financial assistance reward for participation. This instrument would attain the cost-effectiveness advantages of trading and supply the payments from beneficiaries to secure the participation of important cooperative losers. It avoids the perverse effect of side payments on the total level of the externality.

A third cap-and-pay approach would employ tradeable allowances but would embed the compensatory side payments in the allowance trading system itself. In this "cap-and-trade" approach, important source countries that would otherwise be cooperative losers are initially assigned more allowances than would be required to cover their activity levels. These extra ("headroom") allowances represent a valuable asset that the country can use to accelerate its economic growth or sell to earn profits in the allowance trading market. To keep the total global level of externality from expanding when these extra allowances are assigned to cooperative losers, this approach necessarily implies lower initial allowance assignments to the cooperative winner countries than those countries would have received if the cooperative losers did not need to be compensated. The lower allowance assignments are costly to the cooperative winner countries, which must either further reduce their emissions, or purchase additional allowances in the allowance trading market. The cooperative winners are, of course, the beneficiaries of the collective protection regime. Thus, under this approach, the beneficiaries are paying the costs of persuading the cooperative losers to participate by purchasing the headroom allowances assigned to the cooperative losers.[322] The assignment of extra allowances to midwestern electric utilities as part of the 1990 Clean Air Act reflects this approach under Majority rule.[323] The Kyoto Protocol utilizes this approach to engage

322. Aronson nicely demonstrates the ability of a tradeable allowances approach to achieve a game-theoretic solution for global GHG emissions control. In his illustration, the cooperative losers are attracted to participate by the assignment of extra allowances, and the cooperative winners buy back extra allowances at a price that still leaves them net gainers from the global environmental protection. *See* Aronson, *supra* note 11, at 2152-58, 2161-66. But Aronson neglects the option of a tax-and-pay compensation system and does not recognize or analyze the dynamic incentive effects of compensatory side payments on total emissions.

323. Indeed, the acid rain title of the 1990 Clean Air Act is illustrative. *See* 42 U.S.C. §§ 7651-7651o (1994). Imagine that the Congress had not capped SO_2 emissions at 8.9 million tons per year, as provided in 42 U.S.C. § 7651b (1994), but instead had adopted an SO_2 emissions tax estimated to achieve the same level of emissions. Then imagine that compensatory side payments were made in the bill to midwestern states (low-beneficiary sources and hence cooperative losers) in order to buy their assent to the majority coalition needed to pass the bill. The result would have been to tax emissions nationwide, except to rebate that tax in the Midwest, leading to higher rates of industrial growth in the Midwest than elsewhere and to leakage of SO_2-emitting investment to the Midwest, increasing emissions there. By contrast, the real acid rain title conferred side payments in the form of extra quantity allowances, subject to a quantity-based emissions cap, thereby preventing the perverse effect of increased emissions due to the side payments. *See supra* note 283; *see, e.g.*, 42 U.S.C. § 7651d(a)(3) (1994) (allocating additional allowances to midwestern sources). Thus, the quantity-based approach may be preferable under

participation by Russia, but has not (yet) used the cap-and-trade approach with headroom allowances to engage participation by the major developing countries.

The difference between the two tradeable cap-and-pay approaches just mentioned is the currency they use to make compensation payments: financial rewards versus extra tradeable allowances. Both approaches place the same aggregate cap on global emissions or resource uses, which contains the perverse upward pressure of the subsidy component. The difference in compensation currencies is basically the difference between foreign aid and international trade.[324] In the climate policy context, aid would involve cash flows from donor government to recipient government, while trade would involve the investment by industrialized emitters in the transfer of low-emissions technologies to firms in host countries in return for some of the allowances freed up by the attendant emissions reduction. Several considerations suggest using trade rather than aid to deliver compensatory side payments. First, for beneficiary countries making side payments, trade may be less costly than aid where trade generates collateral benefits such as increased employment in the exporting industry, a more fruitful ongoing economic relationship between the two countries, or supplementary improvements in correlated environmental conditions such as regional air quality or biodiversity.[325] Second, aid may be subject to more domestic political opposition than trade; making side payments in official government aid could entail massive outright transfers, whereas allowance trading would entail numerous small transfers from private sources in industrialized countries to lower-cost abaters in developing countries. Although political visibility of the costs of environmental protection is often seen as a desirable characteristic,[326] higher political visibility may be *less* efficient if the political system is distorted (e.g., by xenophobic obstacles to foreign aid). Third, for developing countries, foreign aid may appear to be subject to more bureaucratic constraints and less responsive to

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Majority rule as well. In general, it might be preferable whenever participation has to be attracted with side payments.

324. Another method of compensation might be the provision of political rewards. For example, China might agree to quantity limits on its GHG emissions in return for being admitted to the World Trade Organization (WTO). This kind of linkage is plausible in high-stakes international diplomacy. But such a compensation method is "lumpier" and may yield more errors of over- or undercompensation, or other undesirable consequences outside the environmental protection arena, than would financial or allowance-denominated compensation provided in the environmental protection treaty itself. Still, there might be synergistic benefits of such a deal, because getting China to play by the WTO's free trade rules could be quite important to the success of a tradeable quantity allowances instrument for global environmental protection. *See infra* Section V.C.

325. *See* Dallas Burtraw & Michael A. Toman, *Equity and International Agreements for CO_2 Containment*, 118 J. ENERGY ENGINEERING 122, 131 (1992).

326. *See* Keohane et al., *supra* note 202, at 364.

the local needs of the recipient country than international trade.[327] Fourth, private trade transactions are likely to be more cost-effective and creative and to generate more sustainable investments that benefit host countries than the projects funded by government aid bureaus. If aid is provided by a centralized fund, its cost-effectiveness may be even more impaired relative to competitive private investors, and problems of market power may distort aid choices.[328] Fifth, trade may also be more attractive because it inhibits strategic posturing; monetary payments might be more likely than in-kind technology exports to entice potential recipients to exaggerate the amount of compensation they seek.[329]

The need for Pareto-improving compensatory side payments to engage full participation under the Voluntary Assent voting rule suggests a straightforward approach to the initial assignment of global regulatory burdens. Instead of working out complex formulae combining ability to pay, population, GDP, and other factors, the Pareto-improving approach would assign burdens in proportion to national net benefits of cooperation. The less net benefit (i.e., net of compliance costs) that a country reaps directly from the global environmental protection regime, the less burden it can be expected to undertake initially and still want to participate. If the regime employs tradeable allowances, the initial assignment would need to give extra allowances to countries with lower direct net benefits from the environmental protection regime and fewer allowances to countries with higher direct net benefits.[330] In this way, the initial assignment would match national costs to national benefits. If burdens were assigned to correspond to other typical burden-sharing criteria, such as ability to pay or population, a country could face costs exceeding its benefits, which would lead it to

327. This factor could ironically be an obstacle to developing country governments' assent to an international emissions trading system. Trade in environmental allowances and technologies might better serve the interests of private firms in developing countries, whereas aid might better serve the interests of government elites in these countries.

328. *See supra* Subsection III.C.2.

329. *See* Burtraw & Toman, *supra* note 325, at 132.

330. Along these lines, one analysis argues that the *only* way to achieve a Pareto efficient global solution is through a tradeable allowances approach in which extra allowances are allocated to countries with lower marginal social valuations of consumption. *See* GRACIELA CHICHILNISKY ET AL., INTERNATIONAL EMISSIONS PERMITS: EQUITY AND EFFICIENCY (Stanford Univ. Ctr. for Econ. Policy Research Publication No. 381, 1993). The argument is that because countries place different valuations on global environmental protection, as described *supra* Section II.C, equalizing marginal costs of abatement across countries (e.g., through a tax or ordinary tradeable allowance system) will not be welfare-improving for all countries. Instead, the only initial assignments of allowances that will be welfare-improving for all countries are those that equalize the *ratio* of marginal benefits to marginal costs across countries. This requires assigning additional wealth (in the form of extra allowances) to countries with lower marginal social valuations of climate protection. The authors argue that allowance trading could then attain a Lindahl equilibrium, in which all parties are not merely no worse off but are first-best off. *See id.*; *see also* Robert Dorfman, *Protecting the Transnational Commons*, *in* THE ECONOMICS OF TRANSNATIONAL COMMONS, *supra* note 81, at 210 (describing an initial assignment that attains a Lindahl equilibrium).

decline to participate. Many of these factors would still play a role in the calculus of national net direct benefits. For example, historical emissions would matter in this exercise not as a fixed star for grandparenting allowances, but as an input to the calculation of each country's cost of abatement. Likewise, a country's population and wealth would influence its costs and benefits of restraining emissions. Of course, this inverse-net-benefits approach to burden assignment is not simple; the calculation of national net direct benefits, and the judgment of the number of allowances to assign to a given country, will be complex and hotly contested. But this approach is a key—or perhaps even the only—way toward efficiently engaging global participation.

5. *A Calabresi and Melamedian Analysis*

The argument can also be stated in the Calabresi and Melamed terminology of liability rules and property rules. The status quo ante—no limit on emissions—represents a default pure property rule entitlement to emit. It is conceivable in theory that the status quo could reflect the opposite implicit assumption, namely that victims have an entitlement to zero externality—such that the global environment were a "closed access" resource rather than an open-access resource.[331] An externality itself is an involuntary exchange forced on the victim by the source,[332] so it can hardly be said that victims have voluntarily assented to giving emitters the

331. On "closed access" or "anticommons" property, see Robert C. Ellickson, *Property in Land*, 102 YALE L.J. 1315, 1322 n.22 (1993); Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 667-79 (1998); and Michelman, *supra* note 221, at 6 (referring to an anticommons property regime as a "regulatory regime"). A "closed access" regime for the global environment might be possible where the resource has not yet been exploited in the status quo and the law gives every party a right to exclude all others. Historical examples of such a situation include the Moon Treaty, *see* Treaty on Principles Governing the Activities of States in the Exploration of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, art. II, 610 U.N.T.S.205 (entered into force Oct. 10, 1967) (barring appropriation of rights to outer space, including the moon), the Antarctic Environmental Protocol, *see* Antarctic Treaty, Dec. 1, 1959, art. IV, 12 U.S.T. 794; Protocol on Environmental Protection to the Antarctic Treaty, Oct. 4, 1991, art. 7, 30 I.L.M. 1461 (barring mineral extraction in Antarctica), and the U.N. Convention on the Law of the Sea, *supra* note 48, each of which limited resource extraction before exploitation had begun. The global atmosphere and global biodiversity, however, are far past that point. Emissions and extraction have been ongoing for centuries, and the entitlements of the sources of global externalities are only now being challenged. *Cf.* Ellickson, *supra* note 121, at 731 (noting that Pigou focused on abatement subsidies rather than emissions taxes, since in the era in which he wrote, notions of "normalcy" assigned the initial entitlement to polluters).

332. *See* BAUMOL & OATES, *supra* note 3, at 17-18 (defining an externality as an uncompensated change in *A*'s utility chosen not by *A*, but by others who are not considering the effects on *A*); BUCHANAN & TULLOCK, *supra* note 56, at 71 (defining an external cost as a loss imposed on an individual against which he has no legal recourse); Kaplow & Shavell, *supra* note 5, at 772 ("A harmful externality can often be described as the taking of a thing; for example, a firm that pollutes someone's air can be said to have taken clean air or an easement from the victim.").

entitlement to emit.[333] Perhaps in a first-best world, the entitlement to be free of global pollution would be held by victims. But in the real world, the status quo does not reflect an implicit entitlement in victims to zero global pollution because externality generation is difficult to block ex ante (i.e., the source can physically seize the entitlement by emitting domestically). Victims cannot physically block emissions, or, put another way, victims face prohibitive costs to doing so. They would have to invade the sovereignty of the source country and somehow seal up emissions outlets. The standard problem of open-access resources is that they remain open-access, subject to the "race to capture" by harvesters or polluters, until "mutual coercion" is "mutually agreed upon."[334] So, as a practical matter, like it or not, the present system starts from an implicit entitlement in sources to emit.

Under Fiat, the state can dictate the legal rule: a property rule entitlement in either source or victim, a liability rule requiring payment of damages by source to victim, or a reverse liability rule requiring payment of damages (cost of abatement) by victim to source.[335] Under Fiat, the state could modify the sources' ex ante entitlement to emit by imposing a tax or quantity limit on emissions. Under Voluntary Assent, however, the source will not agree to relinquish its entitlement without being compensated. As Professor Dorfman puts it, the crucial "complication" of international environmental problems is that "the world is divided into entities called 'sovereign nations,' each of which is *entitled* to use, or misuse, the transnational commons in whatever way it considers advantageous, unless it agrees *voluntarily* to forgo some or all of these *rights*."[336] If the status quo represents a property rule to emit, then the victim (the "beneficiary") must

333. A "true" Voluntary Assent rule, starting from an unrealistic neutral status quo, would imply neither the right in polluters to emit nor the right in victims to prohibit emissions. Behind Rawls's veil of ignorance, *see generally* RAWLS, *supra* note 172, people would be uncertain as to whether they would emerge as sources or victims or both. They might rationally choose, under a Voluntary Assent voting rule, a regulatory rule that gives the right to emit neither entirely to polluters (risking losses to victims), nor entirely to victims (risking costs to consumers of polluters' products), but rather might choose a "divided" entitlement that optimizes these conflicting costs (as well as the costs of decisionmaking and other attributes). Under a real-world Voluntary Assent voting rule, however, people have more complete information regarding their actual situations and the net payoffs for moves proposed from the nonneutral status quo.

334. Hardin, *supra* note 57, at 1247.

335. A reverse liability rule (Calabresi and Melamed's "fourth rule")—taxing the victims—may be more efficient than a liability rule—taxing the sources—where the government has better information about the source's cost of abatement than it does about the victim's damages. *See* Calabresi & Melamed, *supra* note 5, at 1116; Kaplow & Shavell, *supra* note 5, at 725 n.37, 742 n.89. Under Voluntary Assent, a liability rule (either direct or reverse) may be more difficult to establish than a property rule because of the lack of an external coercive force (i.e., a court) to set the price that the victims will pay. Calabresi and Melamed note that, compared to a property rule, a liability rule requires an additional element of state intervention not just to assign the entitlement but also to impose its price. *See* Calabresi & Melamed, *supra* note 5, at 1092.

336. Dorfman, *supra* note 330, at 210 (emphases added).

negotiate to purchase the entitlement at a price high enough to cover the source's cost of abatement.[337]

There are then three ways for a victim to make payment to a source: as a direct payment, as compensation for adopting a price constraint (tax/liability rule), or as compensation for adopting a quantity constraint (partial property rule). The quantity constraint approach is best because it avoids the perverse effects of subsidizing the source directly or under a price constraint. The direct payment or the payment for adopting a price constraint will act as a subsidy—necessarily covering the source's full costs of abatement (and the price constraint on unabated emissions) and necessarily proportionate to the source's emissions—hence, attracting increased investment to the source industry. This perverse effect is the "polluter's behavior" moral hazard counterpart to the standard "victims' behavior" argument, which asserts that actual payments to the victim can be inefficient where the victim's behavior is important because the compensatory payment acts as a subsidy to the victim's risk-taking behavior.[338] Likewise, actual payments from the victim to the source can be inefficient where these rules act as a subsidy to the sources' risk-making behavior and thereby increase the size of the group of sources.[339] A quantity

337. Assume arguendo that global environmental law could somehow start from the assumption of an implicit entitlement in emissions in victims to be free of harm ("closed access, zero emissions"). The analysis in Part IV would still apply. Under a Voluntary Assent voting rule, the principle would still have to be "beneficiaries pay," now understood to mean the beneficiaries of the *change from the status quo ante baseline assignment of entitlements*. These beneficiaries would now be the emitters rather than the victims. Victims of GHG emissions who are not also sources (e.g., small coastal and island states) would not agree to incur any environmental harm unless they received compensatory side payments. (Victim countries that are also sources of emissions might agree to allow some emissions because they would also gain from the right to emit.) The compensatory side payments to victims would amount to insurance against their damages and could thus invite inefficient risk-taking behavior by victims (e.g., building new facilities on coasts vulnerable to rises in sea level or failing to adopt low-cost measures to adapt agriculture to rising temperatures). This is the standard problem of the perverse "victim's behavior" moral hazard, induced when actual compensation is paid to victims. *See* BAUMOL & OATES, *supra* note 3, at 23-25; Coase, *supra* note 4, at 2, 12-13, 42; Kaplow & Shavell, *supra* note 5, at 720-21; *see also supra* Subsection III.C.2 (describing the perverse incentives to pollute introduced by subsidies). In a Fiat regime, emissions victims could be forced to accept incomplete compensation under a policy that limits or taxes emissions to some non-zero level but leaves victims incurring the damages caused by the residual allowed emissions. Under Voluntary Assent, reducing the compensation paid to victims would not work because victim countries would not agree to relinquish their entitlement to be free of harm unless they were fully compensated for their net losses. Adding a tax on victims' risk-incurring behavior (e.g., coastal development) would not help because pure victims would have to be compensated for the costs of paying the tax as well, which would offset the incentive of the tax. The solution must be to pay victims compensation for their assent to allowing some harmful emissions, but only if victims accept a quantity-based limit on their exposure to harm, such as a tradeable quantity limit on coastal development. This is the analog to the "cap-and-trade" approach discussed in the text.

338. *See* BAUMOL & OATES, *supra* note 3, at 23-25; POSNER, *supra* note 100, at 169-75, 177, 377; Coase, *supra* note 4, at 2, 42; Kaplow & Shavell, *supra* note 5, at 720-21, 738-39.

339. *See* POSNER, *supra* note 100, at 64 (criticizing "fourth rule" payments to sources as likely to induce excessive risk-making by sources). This possibility is also hinted at by Kaplow and Shavell, who remark that "property rule protection of injurers' right to cause harm . . . [may]

constraint adopted by the source (with side payments to cover the source's net cost of abatement) solves this problem. It suppresses the distortionary effect of the side payments on sources' behavior.

The standard solutions to the "victims' behavior" problem under Fiat are to reduce the compensation to the victim, such as through doctrines of contributory negligence or mitigation of damage,[340] or a Pigouvian tax approach in which the source pays the liability to the state rather than to the victim.[341] But these remedies are unavailable at the global level under Voluntary Assent to deal with the converse "polluter's behavior" problem. Under Voluntary Assent, limiting or denying compensation to the source will result in the source declining to agree to abate. Some means must be found not only to pay compensation to sources, but also to inhibit the perverse incentives this payment creates for sources. The divided property rule—tradeable allowances with extra assignments to cooperative losers—is the best instrument for achieving this result.

C. *Additional Considerations*

1. *Compliance*

Although compliance is a general problem of regulation under any voting rule, it is especially challenging under the Voluntary Assent voting rule, where sources cannot be compelled to comply but must be attracted by the continuing desirability of participation.[342] A common criticism of international tradeable allowances is that assuring compliance would be difficult.[343] Yet the problem of compliance is not unique to tradeable

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come[] at the price of a dilution of injurers' incentives." Kaplow & Shavell, *supra* note 5, at 739. They do not specify, however, whether they are referring to the problem that transaction costs may obstruct victims' ability to purchase from injurers the rights to emit, such that injurers would face inefficiently low incentives to abate risk, or whether they are referring to the problem identified here, of "polluters' behavior," that, even if victims can pay injurers' abatement costs, this very payment would act as a subsidy to the risky industry.

340. *See* Kaplow & Shavell, *supra* note 5, at 738 (identifying such doctrines and criticizing them as inadequately tailored to victims' options and incentives).

341. *See id.* at 738 & n.77; *see also* BAUMOL & OATES, *supra* note 3, at 29 (favoring Pigouvian taxes over tort liability because the taxes do not yield actual compensation to victims and thus avoid the perverse incentives for victims to incur excessive risk).

342. *See* BARRETT, *supra* note 238, at 7; Barrett, *supra* note 58, at 282-83.

343. *See, e.g.*, DAVID HARRISON, JR., CONSIDERATIONS IN DESIGNING AND IMPLEMENTING AN EFFECTIVE INTERNATIONAL GREENHOUSE GAS TRADING PROGRAM 2 (1997) ("National trading programs are organized by governments that have the legal authority to impose regulatory requirements. In contrast, there is no international organization that could require participation of individual countries."); *id.* at 43 ("In summary, taken as a whole, the [difficulties arising from the absence of a supervening legal authority] constitute major, if not insurmountable, barriers to the successful implementation of an international trading program for greenhouse gases."); *see also* Jeffrey C. Fort & Cynthia A. Faur, *Can Emissions Trading Work Beyond a National Program?: Some Practical Observations on the Available Tools*, 18 U. PA. J. INT'L ECON. L. 463, 470-71 (1997) (doubting the ability to enforce compliance with international tradeable permits); *Climate*

allowance policies. *Any* regulatory constraint must be backed by some form of monitoring and verification of national abatement claims and some form of enforcement against noncompliance.[344]

The question is the *relative* ability of the regulatory instruments to maintain compliance. In general, national compliance with conduct instruments, taxes, fixed quantity caps, and allowance trading would all be judged in the same way: by reference to the national emissions inventories of the countries subject to the global constraint.[345] Thus, compliance should be no more difficult to police with allowance trading than with other instruments. The criticisms of weak enforcement of trading systems[346] are really criticisms of the weak ability of the international system and its Voluntary Assent voting rules to assure nation-states' compliance with *any* regulatory obligations. The real root of the problem is the incentive to free ride.[347] Because compliance is costly and benefits of abatement are globally nonexcludable, countries have incentives to defect.[348] Noncompliance amounts to partial or full free riding. "Once free-riding has been deterred, compliance enforcement comes free of charge."[349]

Allowance trading offers significant ways to reduce free riding and improve compliance compared to alternative instruments. First, it reduces the probability of free riding and noncompliance by reducing the cost of compliance and expanding the group of participants.[350] The improved cost-effectiveness of allowance trading itself translates into much less free riding, and hence much less non-compliance, than under more costly regulatory instruments.[351] Second, it adds useful enforcement tools, such as the ability to debit the violator's allowance account for past excesses and the ability to halt trading in the violator's accounts or even expel the

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Change: Electric Utilities See Major Difficulties in Establishing Global Emissions Trading, 28 Env't Rep. (BNA) 368 (June 20, 1997) (reporting an electric utility industry spokesman's concern that an international emissions trading system would be enforced weakly); Steve Pedery, *Sierra Club Blasts Administration Global Warming Plan*, (visited Jan. 13, 1998) <http://www.sierraclub.org/news> (reporting on an environmental group's concern that the system of international tradeable allowances proposed by the United States in the Kyoto talks is "unenforceable").

344. *See, e.g.*, SANDLER, *supra* note 56, at 40-41 (describing taxes, tradeable allowances, and other instruments for internalizing global externalities and concluding that the success of each these instruments "faces severe obstacles because the required infrastructure does not currently exist to implement the standard remedies" at the global level).

345. *See* STEWART ET AL., *supra* note 146, at 26-30.

346. *See supra* note 343 and accompanying text.

347. *See* BARRETT, *supra* note 238, at 16 & n.7.

348. *See supra* Section II.A.

349. BARRETT, *supra* note 238, at 7. Barrett also shows that the mere *threat* of trade sanctions can be sufficient to deter free riding among cooperative beneficiaries. *See* Barrett, *supra* note 58, at 280-82.

350. *See supra* Subsection III.C.1.

351. *See supra* notes 255, 268 and accompanying text.

violator from the market.[352] Third, debiting the violator's allowance account may create new domestic political constituencies pressuring for compliance: investors in the allowance futures and options markets, and prospective buyers of allowances, who stand to lose if future allowances are cancelled. The domestic advocates of compliance would include not just environmental groups but a new swath of financial investors and industry members.[353] Fourth, compared to taxes, allowance trading would be much easier to monitor; nations' compliance with GHG taxes might be essentially unverifiable.[354]

The question remains whether allowance trading might generate special risks of noncompliance. The problem might be fraudulent sales: Country *B* might sell its allowances to Country *A*, pocket the cash, and then continue to emit in excess of its remaining allowances (either snubbing the treaty's requirements or formally withdrawing from the treaty). Under a treaty without allowance trading, of course, Country *B* might also fail to comply (continue to emit in excess of its target, or emit without paying its tax), but Country *A* would not also have purchased allowances giving it the right to increase its emissions as well.

The fraudulent sale scenario, however, seems doubtful. First, it assumes that *B* plays once and for all. Because *B* could earn continued revenues from selling allowances in future years, and noncompliance (or treaty withdrawal) would trigger penalties including prohibition of future allowance sales, repeated allowance trading provides Country *B* an incentive to remain in compliance. Without allowance trading, Country *B* sees compliance as costly, whereas with repeated allowance trading, Country *B* sees compliance as a profit opportunity. Second, this profit opportunity would attract more Country *B*s of the world to subject themselves to the treaty and its monitoring regime; allowance trading thereby helps the treaty to expand its coverage and monitor and manage a larger fraction of global emissions than would a treaty without allowance trading.[355] Third, if the allowances sold by Country *B* were deemed invalid upon *B*'s default, then Country *A* would have no right to increase its emissions (though this remedy would carry its own transaction costs).[356]

352. *See* STEWART ET AL., *supra* note 146, at 44-46. An offsetting debit against the emitter's future allowance allocation is one penalty provided under the U.S. SO_2 trading system. *See* 42 U.S.C. § 7651j(b) (1994). This penalty is in addition to a financial penalty of $2000 per ton of SO_2 emissions in excess of allowances held. *See id.* § 7651j(a).

353. *See* STEWART ET AL., *supra* note 146, at 45.

354. *See infra* Part V.

355. At the same time, the cost-effectiveness gains of allowance trading would attract more "buyer" countries (high-cost abaters) to participate in the treaty.

356. The question is how to allocate the risk of nonperformance in allowance markets. Making allowance buyers "liable" for sellers' nonperformance could encourage buyers to monitor sellers and prevent fraudulent sales. But it could also raise the transaction costs of the allowance trading market and drag down its cost-effectiveness gains. The alternative is to treat

Fourth, the possible incentive to engage in fraudulent sales would almost surely be dominated by the reduced incentive to free ride under allowance trading.

Informal trading (joint implementation or Clean Development Mechanism (JI/CDM) transactions), where seller countries are not subject to national quantity caps, raises special concerns. One is the "domestic leakage" that might occur within the seller country. For example, the carbon stored in trees spared from the axe in one locale and sold as abatement credit to a capped country could be offset by increased logging next door within the same uncapped country. But what matters is the *net* leakage: The leakage from a JI/CDM project within an uncapped country must be compared to the leakage that would have been induced if the same abatement had been required to be undertaken in the domestic economy of the capped country. Net leakage could well be reduced by JI/CDM transactions; for one thing, the incentive for emitters in capped industrialized countries to relocate to uncapped countries would be reduced by the abatement cost savings offered by JI/CDM.[357]

The more serious concerns about JI/CDM transactions in uncapped countries relate to dynamic incentives. If uncapped developing countries can sell JI/CDM credits to buyers in capped wealthy countries at the same price they would sell cap-and-trade allowances, there would be little incentive for the uncapped countries to join the cap regime. As argued above, the prospect of selling formal allowances to higher-abatement-cost countries provides the pivotal incentive for cooperative loser developing countries to participate in the treaty cap; and without their participation, the entire treaty may be futile or worse. If they can earn just as much outside a cap, why should they accept caps? Perhaps the informality and high transaction costs of the JI/CDM market[358] will by themselves make JI/CDM credits less valuable to buyers, so that formal allowances would automatically sell at higher prices than JI/CDM credits. Some discounting of JI/CDM credits could still be needed to reflect their lesser effectiveness

allowance buyers as bona fide purchasers for value holding good title to their allowances, and penalize the nonperforming seller. This approach would enable allowances to be a "global currency" that is not denominated by the country of sale, greatly reducing transaction costs. It would mean that international institutions, rather than buyers, would bear the administrative costs of monitoring sellers' emissions and enforcing compliance through the national inventory reports and independent verification. This is precisely the way compliance would be enforced under regulatory instruments other than allowance trading, so even if compliance assurance is difficult, it could not be *more* difficult under allowance trading. For discussion and endorsement of the latter approach, see STEWART ET AL., *supra* note 146, at 13 & n.17, 44-47.

357. The price-driven leakage effect could also be less acute in less market-oriented developing countries than in highly market-oriented industrialized ones. In other words, high transaction costs in the domestic economy could inhibit leakage.

358. *See* DUDEK & WIENER, *supra* note 206, at 36-40 (examining transaction costs of joint implementation-type pilot projects).

(compared to formal allowances) in achieving actual global abatement.[359] The problems are keeping such discounting tied to actual effectiveness and preventing such a discounting exercise from being hijacked by those who oppose trading altogether. Excessive discounting would forfeit the social gains that JI/CDM could bring in lower-cost global abatement, and in initial participation by developing countries in any abatement at all. These social gains could be large enough to justify a combined approach in which there is both a formal allowance trading market and a recognized but less valuable currency in JI/CDM credits.

2. *Decisionmaking Efficiency*

Because the Voluntary Assent rule typically has higher decisionmaking costs than more coercive voting rules,[360] the ability of regulatory instruments to inflate or economize on decisionmaking costs could be particularly important at the global level. One kind of decisionmaking cost is the administrative cost of operating the regulatory system. Some argue that a tradeable allowances system could not work at the global level without a central agency like the U.S. Environmental Protection Agency to operate the system.[361] Although allowance trading would surely involve some central monitoring and recordkeeping, the issue is the *relative* administrative cost compared to other regulatory instruments. As discussed above, the administrative costs for conduct instruments can be as high or higher than the costs for incentive instruments.[362] Moreover, it is technology-based regulation, not incentives, that depends on a central agency to collect data on sources' abatement costs. Command-and-control regulation works cost-effectively, relative to incentives, only under systems with coercive central planning and information collection.[363] It is in part because of the Voluntary Assent voting rule that international environmental law lacks a strong central administration.[364] Thus, since

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359. *See supra* note 357 and accompanying text (discussing leakage); *supra* Subsections III.C.2, IV.B.4.a (discussing perverse effects of pure payments to abate).

360. *See supra* Section IV.A.

361. *See, e.g.*, Kenneth W. Chilton & Christopher Douglass, *Kyoto Debriefing: Emissions Trading Undercut*, J. OF COM., Dec. 16, 1997, at 7A.

> But the [U.S.] acid rain trading program and any [international] greenhouse gas cap-and-trade system have some important differences. Perhaps the most important difference is the ability to administer and monitor the two programs. The acid rain trading scheme is . . . overseen by the U.S. Environmental Protection Agency. That agency has a team of inspectors, administrators and expensive monitoring equipment already in place to ensure . . . that companies honor their commitments.

Id.

362. *See supra* Subsection III.C.1.

363. *See supra* note 164; *cf.* Stewart, *supra* note 166, at 337 (comparing command-and-control regulation to central planning).

364. *See supra* note 243.

gathering detailed firm-level information to set technology standards is difficult for a national government, it would be even more difficult for an international institution. The comparative weakness of central administration at the global level renders the *relative* advantage of incentives over alternative instruments even *greater* in the international setting.

A second kind of decisionmaking cost is the cost of negotiating the initial assignment of regulatory burdens. Critics of GHG allowance trading often argue that it requires a divisive negotiation over how to assign the allowances among countries.[365] But the initial assignment issue cannot be avoided under *any* regulatory instrument. Even seemingly neutral targets, such as holding all countries to 1990 emissions levels, or imposing a uniform tax, would result in widely varying social costs for countries with differing economic growth rates, different opportunities to employ substitute fuels and products, and other factors. Some allocation of burden, implicit or explicit, is unavoidable. There is no way to avoid negotiating over these distributional impacts. Every regulatory instrument requires an initial decision on how the regulatory constraint on emissions or resource use will be assigned across regulated entities.[366]

Allowance trading, however, can uniquely ease the initial assignment problem. Formal allowance trading makes the initial assignment of burdens explicit, which can make the assignment easier to discuss and resolve. More importantly, a market-based allowance trading policy allows post-agreement reallocations through market trades. A country fearing that a target might prove more expensive than predicted knows that, with trading, it will be able to look to abatement opportunities in lower-cost countries, easing its predicament. This is a version of the Coase Theorem: Where transaction costs are low, voluntary reallocations of entitlements can make the initial legal assignment irrelevant to the ultimate assignment.[367] Where transaction costs are significant, such reallocations would be frustrated. Hence, to maximize cost-effectiveness and ease the allocation impasse, a primary goal of the market-based policy should be to keep transaction costs low. Without trading, there is no way to reallocate burdens once adopted, so

365. *See, e.g.*, HARRISON, *supra* note 343, at 22 ("Unlike a national trading program in which the legal authority exists to impose an [allowance] allocation formula . . . there is no international body that can impose a formula on independent countries. . . . [N]egotiations would be difficult and complex . . . ."); Cooper, *supra* note 9, at 70-72, 74, 78.

366. As Robert Hahn writes: "Cooper . . . contends that tradable permits are not feasible because it will be politically impossible to agree on a baseline. Cooper's critique of international tradable permits also applies to his own tax proposal. It is hard to see how a taxation approach would be feasible in the short term for the developing world . . . ." HAHN, *supra* note 83, at 43.

367. *See generally* Coase, *supra* note 4. The distributional impact of initial allowance assignments could be significant and could affect subsequent transactions among the regulated entities if the wealth effects are large enough to influence their preferences, such as their willingness to pay to acquire an additional tradeable allowance.

an inflexible initial assignment is seen by the parties as determinative, and this realization obstructs negotiations and agreement. The prospect of post-adoption allowance trading could thus substantially defuse the initial assignment impasse.

A third kind of decisionmaking cost is the ability to adjust the regulatory constraint as conditions change. Different instruments imply different abilities to adapt regulations to changing circumstances. Conduct rules require a central agency to update requirements as technologies, substitutes, and other factors change; incentives allow private actors to make such choices continuously.[368] Monetary inflation erodes taxes and requires them to be adjusted or indexed to maintain the same environmental effect; and quantity constraints can become more costly with industrial growth. Outside the world of Fiat, the political constituencies interested in the regulatory constraint can also influence adjustability. Allowance holders might resist subsequent proposals to tighten the regulatory constraint if that would mean canceling or expropriating their allowances without compensation. The government could assert the authority to rescind allowances without compensation,[369] but the risk of confiscation might impair the ability of the allowance trading market to control emissions efficiently. Yet compensating for rescinded allowances would require raising revenues or deficit spending. So, whether compensation is paid or not, tightening the constraint under an allowance trading policy will confront political opposition from some quarter. Meanwhile, similar political obstacles to tighter stringency would arise under a tax because tightening policy stringency would mean raising the tax rate over the protests of taxpayers. Relaxing the constraint, on the other hand, would please taxpayers and potential new allowance purchasers. But current allowance holders might resist relaxing the constraint because such relaxation would devalue currently held allowances.[370] Thus, tradeable allowances may be less amenable to subsequent relaxation than taxes.

368. *See* Bohm & Russell, *supra* note 5, at 400, 416, 426, 447-52.

369. *See, e.g.*, 42 U.S.C. § 7651b(f) (1994) ("An allowance allocated under this subchapter is a limited authorization to emit sulfur dioxide in accordance with the provisions of this subchapter. Such allowance does not constitute a property right. Nothing in this subchapter . . . shall be construed to limit the authority of the United States to terminate or limit such authorization.").

370. This has been the experience with taxicab medallions in New York City. The city allocated just fewer than 12,000 taxi medallions in 1937, and, despite growth in demand for taxi rides as the city's population grew, pressure from current medallion owners to retain their advantaged position forestalled the issuance of any additional medallions until 60 years later, when the city added a paltry 400 (less than a 4% increase) in 1996. *See A Revolution! New York's Cabs*, ECONOMIST, Feb. 2, 1996, at 21.

3. *Fairness*

As indicated above in Part III, fairness is especially important at the global level because of the wider wealth gap between rich and poor and because of the comparative lack of redistributive mechanisms at the global level.[371] In addition, fairness is especially important under the Voluntary Assent rule because countries' perceptions of whether an agreement is fair will substantially influence whether they agree to participate. Under Voluntary Assent, fairness is thus itself a key determinant of adoption. This aspect can be ignored under Fiat and neglected under Majority rule.

If wealthy countries value global environmental protection more highly than poor countries (which place higher priority on local and immediate needs), then the Beneficiaries Pay Principle implied by the Voluntary Assent voting rule will usually be consistent with considerations of fairness. It will entail wealthier countries paying poorer countries to generate global environmental protection services such as GHG abatement and biodiversity conservation. Applying the Polluters Pay Principle will often mean asking some poorer but industrializing countries, such as China and Brazil, to bear the cost of not developing for the benefit of wealthier countries. Poor countries are unlikely to consent to these regressive requests.[372]

There are some cases where poorer countries benefit more from global environmental protection, such that the Beneficiaries Pay Principle would be regressive. For example, the beneficiaries of preventing climate change include both wealthy environmentalist countries (such as the members of the European Union) and poorer coastal countries (such as the members of the Association of Small Island States, or AOSIS). The Beneficiaries Pay Principle implies that the EU and AOSIS might have to pay China, or even the United States, to abate GHG emissions.[373] At some point this problem could become a recognition that the net global payoff from climate protection is negative and that the treaty regime is not worth pursuing. Yet there could clearly be situations in which global protection is desirable but the Beneficiaries Pay Principle is at odds with distributional equity. No single fairness criterion will be universally recognized.[374] The promise is

371. *See supra* Subsection III.C.1. The lack of redistributive mechanisms is in part the result of the Voluntary Assent voting rule itself: Coercive majority voting facilitates redistribution, whereas a unanimity rule precludes pure redistribution. *See* MUELLER, *supra* note 221, at 103-08.

372. *See* HUMPHREYS, *supra* note 111, at 162-71; SANDLER, *supra* note 56, at 95-97; d'Arge & Kneese, *supra* note 54, at 443; *supra* Subsection IV.B. In the case where the same countries are both the beneficiaries and the sources, such as in the CFC phaseout, then the BPP and PPP approaches may yield the same result.

373. It is debatable whether the United States would suffer a cooperator's loss under a GHG limitation regime and therefore require compensatory side payments if it is to be engaged in emissions limitation. *See* Aronson, *supra* note 11, at 2158-60 (suggesting that the United States might be a cooperative loser in GHG control); Nordhaus & Yang, *supra* note 60, at 762.

374. *See* Burtraw & Toman, *supra* note 325, at 122.

that the Beneficiaries Pays Principle will yield fair transfers more often than the Polluters Pay Principle, so long as the priority put on environmental protection correlates with wealth.

As described in Part III, a system of tradeable allowances could be more fair to developing countries than alternative regulatory instruments because allowance trading with extra allowances assigned to developing countries would guide technology and resource flows to developing countries, and the associated cost savings to industrialized countries would mitigate a reduction in industrialized countries' purchases of product imports from developing countries. Moreover, under the Voluntary Assent voting rule, the explicit attention to initial assignment invited by the tradeable allowance instrument may help ensure that poorer countries obtain a more equitable share of global assets in international negotiations. Where the assignment is implicit, unfairness can go unnoticed. For example, in the Law of the Sea treaty, exclusive fishing rights were extended from twelve miles to 200 miles from coasts. This amounted to an assignment of partial geographic property rights in what was formerly the unowned oceans, in a way that favored coastal countries while removing large fishing areas from the global commons.[375] Although privatization of global fisheries may well be desirable on efficiency grounds to prevent overharvesting, the assignment of those fishing rights implicates fairness considerations. If the fishing zones had been made tradeable, it would have been clearer that any country—even a noncoastal country—could acquire such rights. This would have invited a more equitable initial distribution of the new exclusive zones. Noncoastal countries could have sought a share of the fishing rights, even if they only meant to trade that entitlement to coastal countries in return for other valuable consideration. If the rights to fish in the currently unowned high seas are privatized in the future, explicit assignment of tradeable high seas fishing rights would similarly benefit noncoastal countries.

4. *Morality*

The Voluntary Assent rule adds further reasons to eschew the moralist claim, reviewed in Part III, that one should not buy or sell the right to pollute. First, the state's moral authority to teach an antipollution message is less potent. Fiat or Majority rule can compel bad actors to live by a moral creed, but under the Voluntary Assent rule, there is no such power to enforce public morality. To the extent that the moralist position depends on the ability to compel right behavior by bad actors, pressing the moral message under the Voluntary Assent rule could be seen as a sham: touted

375. *See* Hollick & Cooper, *supra* note 81, at 143; *supra* note 149.

but flouted. This may only serve to delegitimize the moral message. The message ultimately communicated could be the irrelevance of morals, not their sanctity.

Second, at the global level there are multiple national cultures and moralities. Placing blame may accomplish less in this plural setting than it could within one society under Majority rule. Enforcing an antipollution moralism against developing countries, for example, will undoubtedly confront the rejoinder that ecoimperialism is itself immoral and that poor countries have a moral right to develop as industrialized countries did. The clash of moralities would be difficult to resolve and ultimately would be unproductive in protecting the shared global environment.

Third, under Voluntary Assent, the moralist stance against tradeable allowances and in favor of condemning polluters would raise the costs of pollution control and effectively forfeit participation by the cooperative losers. The irony of moralism[376] would be heightened because strictly punitive regulation would virtually guarantee less global control of pollution, making the moralist herself the "person to blame for causing pollution." The moralist position would yield incomplete coverage, leakage, and continuing or increasing net pollution; or it would have to employ side payments to attract cooperative losers, in which case the moralist would be paying polluters not to pollute, in violation of the original moral claim. In sum, the moralist stance does not get very far under a Voluntary Assent legal system.

D. *Implications*

The argument presented in this Part strongly suggests that tradeable allowances enjoy a presumptive advantage over other instruments under the Voluntary Assent voting rule that prevails at the global level. All other policy attributes hypothetically held equal, the less coercive the voting rule, the more important "participation efficiency" becomes. As participation must be attracted instead of compelled, taxes become less effective, side payments become more essential to securing participation, revenue recycling becomes less feasible, the risk of perverse incentive effects due to side payments rises, and, consequently, the advantage of quantity-based tradeable allowances grows.

The other attributes of regulatory instruments examined in Part III must also be considered. The presumptive advantage of tradeable allowances could be rebutted by showing that cooperative losers are unimportant or that other attributes (such as abatement cost uncertainty) weigh more heavily in favor of another instrument (such as taxes) than participation

376. *See supra* Subsection III.C.1.

efficiency weighs in favor of tradeable allowances. All I have sought to establish here is that the Voluntary Assent voting rule at the international level substantially changes the comparison of regulatory instruments. At the very least, the legal framework obtaining at the international level requires that we envision ways to make all regulatory instruments compatible with participation-securing side payments. A complete comparative analysis of instrument choice must account not only for such policy attributes as cost-effectiveness, dynamic innovation, administrative cost, fairness, performance under uncertainty, and revenue recycling, but also for what I have termed "participation efficiency." Whether the ultimate champion of the regulatory Olympics will be tradeable allowances or taxes must await such a comprehensive, multi-attribute analysis, based on the empirical realities of particular global environmental problems. Here I argue only that the important role of participation efficiency at the international level, as a consequence of the Voluntary Assent voting rule, gives tradeable allowances a prima facie head start for global environmental regulation. Picking the winning instrument for global environmental regulation without paying attention to participation efficiency is a bad bet—one that may yield serious policy errors.

The argument in this Part suggests that the adoption of quantity-based instruments rather than taxes in the Montreal Protocol, the Kyoto Protocol, and the U.S. acid rain program may have been prudent. In each case, substantial side payments seemed necessary to obtain the requisite participation. The U.S. acid rain program assigned extra tradeable allowances to midwestern sources, instituting side payments to secure majority coalition support while capping aggregate emissions.[377] The Montreal Protocol adopted quantity limits and direct financial side payments, but it sacrificed cost-effectiveness by not adopting formal tradeable allowances.[378] Although the Kyoto Protocol did appear to employ tradeable allowances with extra "headroom" allowances as quasi-side payments to secure the participation of Russia and the Ukraine,[379] it failed to do so to attract major developing countries such as China to adopt quantitative GHG emissions limits.[380] The prospect is that GHG emissions will grow in developing countries (perhaps even perversely spurred by uncapped joint implementation and Clean Development Mechanism subsidies) and emissions-intensive activities will "leak" from capped industrialized countries to uncapped developing countries. If efficient

377. *See supra* notes 283, 323 and accompanying text.

378. *See* Bohm, *supra* note 132, at 30, 317, 325-30.

379. Rather than seeing this headroom as illegitimate "hot air," analysts should recognize the assignment of extra tradeable allowances to Russia as the compensation price that had to be paid to secure participation by a major nonbeneficiary source (cooperative loser).

380. *See supra* note 72.

climate protection is the goal, the Kyoto treaty should be amended or renegotiated with a new simultaneous assignment of formal tradeable allowances to both industrialized and developing countries, constraining global emissions at some level while conferring Pareto-improving compensatory side payments on developing countries.

The presumptive advantage of quantity-based instruments will also apply in other contexts in which the Voluntary Assent voting rule operates. For example, assume that a neighborhood homeowners' association wanted to limit noise but had to secure the voluntary assent of all concerned members to a set of restrictive covenants.[381] Paying dissenting (noise-loving) owners their costs of noise abatement (to gain their assent to the noise-limiting covenant) would create perverse incentives for more noise-lovers to move into the neighborhood and for neutral members to posture as noise-lovers. Imposing a tax on noise would yield nonparticipation by noise-lovers. A tax combined with side payments to noise-loving owners would undermine the tax and create similar perverse incentives to overinvest in noisiness. But imposing a limit on the quantity of noise (say, a maximum decibel level) and making the same side payments would not vitiate the quantity limit.[382]

This analysis may also reveal a more deep-seated reason for the difference between the Pigouvian and Coasean approaches than has been previously recognized.[383] The crucial dividing line may be the different voting rules assumed by Pigou and Coase. Pigouvian taxes or liability rules assume the existence of a regulatory state capable of imposing external social costs on unwilling sources.[384] The entire premise of liability rules and taxes is that the price of the entitlement can be set by a third party, namely the state sitting as adjudicator or regulator.[385] But Coasean property entitlement bargains assume voluntary agreements among the parties. Indeed, Coase pointedly contrasted his vision of efficient entitlement transactions with the coercive world of Pigouvian taxes and state

381. *See supra* note 287.

382. A similar analysis could be developed for consensus-based "regulatory negotiations." And an analysis of this dynamic could be relevant even under Majority rule. On the case of the 1990 U.S. acid rain trading program and the efficiency of tradeable quantity-based side payments, see *supra* note 323. *Cf.* Sigman, *supra* note 284 (arguing that pure coercion yields midnight dumping and that side payments with quantity limits would be more effective).

383. For different perspectives on this question, compare A.W. Brian Simpson, *Coase v. Pigou Reexamined*, 25 J. LEGAL STUD. 53 (1996), with R.H. Coase, *Law and Economics and A.W. Brian Simpson*, 25 J. LEGAL STUD. 103 (1996), which responds to Simpson.

384. *See supra* Section III.A, notes 84-86 and accompanying text. Pigou was explicit. In the midst of his famous passage on taxes and bounties to internalize externalities, he wrote: "No 'invisible hand' can be relied on to produce a good arrangement of the whole from a combination of separate treatments of the parts. It is, therefore, necessary that an authority of wider reach should intervene and should tackle the collective problems of beauty, of air and of light . . . ." PIGOU, *supra* note 3, at 195.

385. *See* Calabresi & Melamed, *supra* note 5, at 1092.

intervention.[386] Coase's framework of trade in property rights is most at home under Voluntary Assent where no coercive state is available to intervene. Stepping back from debates over liability rules versus property rules under different degrees of transaction costs or judicial accuracy,[387] we can see that a fundamental distinction between the Pigouvian and Coasean approaches is the voting rule under which each is the presumptively appropriate remedy: Pigouvian price constraints work best under Fiat, while Coasean quantity entitlements work best under Voluntary Assent. At the least, no comparison of regulatory instruments is complete if it neglects the implications of the underlying voting rule.

V. CHOICE OF REGULATORY INSTRUMENTS UNDER ALTERNATIVE IMPLEMENTATION STRUCTURES

A second fundamental characteristic of the international legal context is its implementation structure. A polity may implement its regulatory edict through unitary, federalist, or jurisdictional structures. This Part shows that the implementation structure, taken as given, significantly affects the choice of the optimal regulatory instrument.[388] In particular, this Part shows that as the polity moves from a centralized unitary structure to a jurisdictional structure, the relative desirability of quantity instruments over price instruments grows.

A. *The Range of Implementation Structures*

Most analyses of instrument choice assume that regulation can be imposed directly on sources with no intervening level of government. This is a "unitary" implementation structure. But global regulatory instruments cannot be imposed directly on sources; they must be implemented through subsidiary political jurisdictions—nation-states. I call this a highly "jurisdictional" structure. An intermediate framework is "federalist,"

386. *See* Coase, *supra* note 4, at 39-44.

387. *See* POSNER, *supra* note 100, at 57; Ayres & Talley, *supra* note 209.

388. I take the implementation structure as given—as an independent variable. I do not argue in favor of one or another implementation structure. There is a voluminous literature comparing the merits of different implementation structures, such as decentralized state and local control, centralized national or global control, and mixed versions such as federalism. *See, e.g.*, Engel, *supra* note 74; Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570 (1996); Revesz, *supra* note 56; Revesz, *supra* note 274; Richard B. Stewart, *Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementation of National Environmental Policy*, 86 YALE L.J. 1196 (1977); Charles M. Tiebout, *A Pure Theory of Local Expenditures*, 64 J. POL. ECON. 416 (1956); Richard O. Zerbe, *Optimal Environmental Jurisdictions*, 4 ECOLOGY L.Q. 193 (1974). I assume here that the implementation structure, like the voting rule, is a fairly permanent feature of the legal framework that does not change quickly.

involving an overarching federal state within which subsidiary jurisdictions still play important roles.[389]

It is helpful to see regulatory implementation as a principal-agent relationship. In a unitary polity, regulatory instruments chosen by the legislature are implemented by the executive. The legislature then has several mechanisms available to monitor and manage the executive's implementation efforts.[390] In the international legal framework, nation-states act as both principals and agents in global environmental regulation. They are the principals who adopt the regulatory regime, and they are also the agents who must implement it. Each nation-state is an agent for the collective of all nation-states. Even assuming that every country qua principal agrees to adopt a global regulatory regime, each country qua agent also faces incentives to implement the regime domestically in a way that maximizes its economic position relative to other countries (even while remaining in facial compliance with the global regulatory agreement). The collective countries qua principals (or an intergovernmental organization acting as the go-between) face high costs of monitoring and controlling the internal conduct of each powerful nation-agent.

As a result, in a highly jurisdictional structure, the regulatory regime is more vulnerable to impediments and distortions introduced by the intermediate national governments qua implementing agents. The analysis in this Part shows that these jurisdictional impediments pose problems for both tradeable allowance and tax instruments, but that these problems are

389. National law typically involves important subsidiary jurisdictions—states, provinces, and local governments. *See* Farber, *supra* note 223, at 1315 (explaining that in the United States, national environmental policy often requires negotiating implementation by the states); Stewart, *supra* note 388, at 1196 ("The federal government . . . is dependent upon state and local authorities to implement [environmental] policies . . . ."). Hence, the problem of implementation by intermediate state agents can be important at all levels of governance, and my analysis in this Part has implications for national instrument choice as well. Still, the global legal framework is clearly more significantly "jurisdictional" than most or all national systems. The United States is a federalist system in which the states possess much authority, but many environmental regulations are imposed directly by the national government on private sources without much or any role for the states. At the least such a unitary approach to implementation is within the legal power of the national government under the Commerce Clause. *See* U.S. CONST. art. I, § 8, cl. 3. An example is the SO_2 emissions trading system created in the 1990 Clean Air Act amendments, which operates directly on emitters without respect to state lines, treating the nation as a unitary polity. *See* 42 U.S.C. §§ 7651-7651o. By contrast, at the global level, environmental law can rarely if ever operate directly on private sources of externalities. International law must in general be adopted and implemented by nation-states. Beyond this official sovereign autonomy, the practical power of nation-states to thwart or distort international legal requirements is far greater than the practical power of states within the United States or even the European Union to act at variance with the laws of their federal governments. Compared to the member states of the United States or the European Union, nation-states have far greater financial, technical, informational, and military resources than the international institutions set up to govern them.

390. *See* Matthew D. McCubbins, Roger G. Noll & Barry R. Weingast, *Structure and Process, Politics and Policy: Administrative Arrangements and the Political Control of Agencies*, 75 VA. L. REV. 431 (1989); Barry R. Weingast, *The Congressional-Bureaucratic System: A Principal-Agent Perspective*, 44 PUBLIC CHOICE 157 (1984).

more serious and intractable for tax instruments. Thus, the jurisdictional implementation structure at the global level is another legal parameter furnishing a presumptive advantage to quantity-based allowance trading instruments over price-based tax instruments.

To date, most analyses of global environmental law have paid little or no attention to the role that the jurisdictional implementation structure may play in making the choice among regulatory instruments. Analyses of the cost savings of global allowance trading, for example, typically assume fluid transactions across national borders among profit-maximizing private sector allowance holders, and take no account of interjurisdictional trade barriers or transaction costs, or of the jurisdictional exercise of market power.[391] Likewise, most analyses comparing liability and property rules assume that the choice occurs within one political jurisdiction; they do not address the problems of imposing such rules across jurisdictions to deal with multijurisdictional externalities. The choice among regulatory instruments at the global level requires much further examination of these issues.[392]

B. *Jurisdictional Barriers to Taxes: Fiscal Cushioning*

A jurisdictional structure introduces a problem of local circumvention. Under a global GHG tax or set of nationally coordinated GHG taxes, for example, countries would have incentives to counteract the burden of the global regulatory regime on domestic high-emitting or resource-intensive industry sectors by adopting offsetting tax cuts, subsidies, and new taxes on substitute products. The complexity of national tax codes could make it very difficult for outsiders to monitor these domestic cushioning strategies.[393] Each country qua agent for the global collective regulatory regime could engage in opportunism that remains facially faithful to the global regime but distorts the regime's effects. As the chief U.S. negotiator at Kyoto, Stuart Eizenstat, argued:

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391. *See* sources cited *supra* note 155.

392. *See generally* PARSON & FISHER-VANDEN, *supra* note 156 (discussing regulatory instruments in light of host-government policies and politics). An analogous problem in national implementation of environmental markets is that new national systems of tradeable allowances have to be grafted onto the preexisting system of state-by-state regulation. *See* Hahn & Noll, *supra* note 154, at 65.

393. I am grateful to David Bradford for discussion of this point. *See also* MABEY ET AL., *supra* note 70, at 25 (noting that GHG taxes are "open to verification problems, because any increases could be potentially offset by reducing existing domestic energy taxes leading to free-riding while in full compliance with the treaty!" (citation omitted)); Stavins, *supra* note 6, at 322 (arguing that global taxes could be frustrated by domestic tax and subsidy changes). Mabey et al. also point to other problems in harmonizing global GHG taxes with the very diverse tax systems of nation-states (in order to achieve efficient equalization of marginal abatement costs across countries). *See* MABEY ET AL., *supra* note 70, at 331.

> [A] common international tax is a bad idea. Countries with existing energy taxes could reduce them while a new international carbon tax was imposed on countries without preexistent energy taxes. The net effect would be little, if any, reduction in emissions.... [C]ountries could offset the impact of a new carbon tax indirectly, through other changes in tax or subsidy policies... while ostensibly maintaining their existing energy taxes. Distinguishing permissible from prohibited policies would be extraordinarily difficult and could bring unacceptable international scrutiny to domestic tax decisions.[394]

In Thomas Heller's view, "The strongest argument in favor of trading over taxes is that with multiple, uncoordinated fiscal and regulatory policies affecting the price of energy, changes in other policies may offset the effects of the carbon-energy tax."[395]

Of course, such tax relief and subsidy games might be played to cushion domestic industries from the costs of complying with any instrument—technology requirements, taxes, or tradeable allowances. But whereas these strategies could not influence the total emissions or resource uses of the country under a quantity-based regime, they would influence the total emissions or resource uses under an international tax or technology regime. Precisely because the tax does not limit the total quantity of emissions, the domestic cushioning strategy would dilute both the economic and the environmental effects of the global tax. Under a global quantity rule, by contrast, although the domestic cushioning strategy could ease the competitiveness burden facing the country, it could not generate perverse increases in the contributions to the global externality, because the quantity limit would set an upper ceiling. In addition, because taxes cost regulated firms more than do conduct standards and issued allowances,[396] the incentive for domestic industry to lobby for cushioning would also be higher under taxes than under alternative instruments. Just as important, the ability to monitor the global impact of domestic cushioning would be greater under quantity instruments than under taxes. Under a quantity instrument, the group of nations qua principals need not monitor all the domestic evasive tactics being practiced in each country (as would be

394. Stuart Eizenstat, *Stick with Kyoto: A Sound Start on Global Warming*, FOREIGN AFF., May/June 1998, at 119, 120 (rebutting the advocacy of an international greenhouse gas tax in Cooper, *supra* note 9).

395. Thomas Heller, *The Path to EU Climate Change Policy*, *in* GLOBAL COMPETITION AND EU ENVIRONMENTAL POLICY 108, 122 (Jonathan Golub ed., 1998). Robert Stavins reaches a similar judgment, concluding that "the weight of evidence would appear to favor... a permit scheme over a charge system at the international level," based largely on concern about nations' internal efforts to circumvent the effectiveness of a global tax. Stavins, *supra* note 6, at 323.

396. *See* BREYER, *supra* note 2, at 281; Buchanan & Tullock, *supra* note 203, at 141; Keohane et al., *supra* note 202, at 347-51.

needed to assure the global effectiveness of a tax). Instead, the group of nations qua principals need only monitor the aggregate national emissions and compare them to the country's allowed total. Thus, *real* effectiveness (as opposed to facial compliance) would be much *easier* to monitor under globally tradeable allowances than under a global tax.

C. *Jurisdictional Barriers to Tradeable Allowances*

The greater disjunction of jurisdictions at the international level may also pose problems for global allowance trading that are less relevant or absent for national allowance trading systems. Within the United States, there is a national market: States' interference in the national market is constrained by the federal Constitution; property rights established under the law of one state are valid in other states; and although transactional law varies somewhat from state to state, a high degree of uniformity is fostered by the Uniform Commercial Code and the national education provided in law schools. The U.S. dollar and federally issued SO_2 emissions allowances are examples of nationally created commodities that transcend state law. At the international level, by contrast, there is a collection of national and regional markets. Interference with international trade is commonplace, national property rights are not always recognized in other countries, and transactional law varies considerably across jurisdictions. There are as yet few or no instances of globally created commodities that transcend national law.

This Section shows that such obstacles to international allowance trading, while important, can be mitigated by the careful design of international allowance trading systems and by the momentum toward open global markets in general. Thus, these obstacles are less insuperable for allowance trading than is the problem of domestic cushioning for taxes.

1. *Interference*

Nations may meddle in the global allowance trading market to secure competitive advantage. They might tax allowance sales or purchases, limit compliance options, expropriate allowances or abatement projects, or undertake other schemes. The experience of the U.S. SO_2 trading system is instructive. Allowances were assigned to the emitters directly rather than assigned to the states. Nonetheless, several states attempted to distort the national market in SO_2 allowances. Some tried to limit fuel-switching to out-of-state low-sulfur coal[397] but were generally rebuffed under the

397. *See Pollution Control: Unshackling the Invisible Hand*, ECONOMIST, Jan. 4, 1992, at 66 (reporting that in response to the 1990 acid rain trading program, Ohio, Kentucky, and West

dormant Commerce Clause of the U.S. Constitution.[398] Other states tried to limit allowance sales to upwind out-of-state sources.[399]

At the global level, this problem would be more acute. First, even assuming that global environmental protection allowances would be created under international law rather than national law,[400] they would initially be assigned to national governments. Perhaps there would be a treaty obligation on national governments to subassign the allowances to private sources, but this might be left up to each nation. Thus, national governments would initially control the allowances and might not undertake subassignment. Unlike private allowance holders, governments might not maximize profits and might instead use allowances in inefficient ways.

Second, even if subassignment to the private sector did occur, national governments could seek to interpose obstacles to free trade in allowances across borders, just as they do now in ordinary markets. National meddling in an international GHG emissions allowance market might be rebuffed under the law of the General Agreement on Trade and Tariffs (GATT) and the World Trade Organization (WTO), but this depends on untested legal questions about how trade in GHG abatement is classified: Is it a commodity, a service, an investment; or even covered under the GATT?[401]

Virginia threatened to prevent in-state electric utilities from switching to out-of-state low-sulfur coal).

398. *See, e.g.*, Alliance for Clean Coal v. Miller, 44 F.3d 591, 596 (7th Cir. 1995) (striking down an Illinois law subsidizing the use of coal with high sulfur content enacted in response to the 1990 acid rain SO_2 trading program); *see also* ELIZABETH BAILEY, ALLOWANCE TRADING ACTIVITY AND STATE REGULATORY RULINGS: EVIDENCE FROM THE US ACID RAIN PROGRAM, (MIT Ctr. for Energy and Envtl. Policy Research Working Paper No. 96-002, 1996) (discussing states' efforts to obstruct SO_2 allowance trades, and judicial review of such efforts).

399. *See* Deborah M. Mostaghel, *State Reactions to the Trading of Emissions Allowances Under Title IV of the Clean Air Act Amendments of 1990*, 22 B.C. ENVTL. AFF. L. REV. 201, 209-10 (1995) (describing legislation proposed in New York and Wisconsin); Al Baker, *LILCO To Curb Sales of 'Pollution Credits,'* NEWSDAY, Apr. 30, 1998, at A33 (reporting on an electric utility's agreement with Governor Pataki of New York not to sell allowances to power plants in 15 mostly upwind midwestern states, including Ohio, Indiana, Pennsylvania, and Kentucky); *Pollution Control*, *supra* note 397, at 66 (reporting that in response to the 1990 acid rain trading program, "meddling regulators" in New York tried to limit sales of allowances to upwind emitters).

400. It is hard to imagine a country agreeing to have its economy constrained by property rights that are subject to definition and interpretation according to another country's national laws. For example, suppose the U.S. economy could emit up to the total of its allowances held, but the definition and enforcement of the allowance as a property right was a matter of French law, or vice-versa. It is far more likely, perhaps inevitable, that the allowances would be created and defined under the international treaty itself.

401. *See* STEWART ET AL., *supra* note 146, at 35-40. Note that some countries that would be potentially important members of a GHG allowance trading market, such as China and Russia, are not yet full members of the WTO and thus might not be bound by the GATT/WTO restrictions on interference with international trade.

Another possible basis for ensuring free trade in environmental allowance commodities is protection under the *Convention on Contracts for the International Sale of Goods* (CISG), Apr. 11, 1980, 19 I.L.M. 668. For discussions of this convention, see JOHN O. HONNOLD, UNIFORM

It is also unclear whether the GATT/WTO applies to trade in commodities defined under international rather than under national law.

This problem is the converse of the traditional "trade and environment" debate. The traditional "trade and environment" argument is that global free trade rules may undermine national environmental protection efforts.[402] But here the concern is that restrictions on trade in environmental regulatory commodities, such as GHG emissions allowances, would obstruct global environmental protection efforts. Instead of worrying that free trade in ordinary products would undermine national environmental protection laws, the worry is that global environmental protection would be undermined by national trade-protection laws. Thus, GATT/WTO free trade rules applied to international trade in environmental allowances could enhance, not impair, effective and efficient global environmental protection.

2. *Transaction Costs*

High transaction costs can impede the efficient functioning of environmental allowance trading markets.[403] Allowance trading markets confront at least six kinds of transaction costs: searching for partners, negotiating deals, gaining regulatory approval, monitoring performance, enforcing deals, and insuring against the risk of nonperformance or project failure.[404]

As compared to a unitary polity, a jurisdictional implementation structure raises several kinds of transaction costs. Greater diversity in the legal and economic systems across countries will raise negotiation and

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LAW FOR INTERNATIONAL SALES UNDER THE 1980 UNITED NATIONS CONVENTION (1991); Henry D. Gabriel, *A Primer on the United Nations Convention on the International Sale of Goods: From the Perspective of the Uniform Commercial Code*, 7 IND. INT'L & COMP. L. REV. 279 (1997); and Note, *Unification and Certainty: The United Nations Convention on Contracts for the International Sale of Goods*, 97 HARV. L. REV. 1984 (1984).

402. *See, e.g.*, GURUSWAMY & HENDRICKS, *supra* note 67, at 402-03 ("The WTO['s] existence and active presence accentuates the reality that international free trade and environmental protection are competing paradigms."); Stewart, *supra* note 68, at 2071-84 (examining empirical evidence of conflict between free trade and environmental regulations). The trade and environment conflict is argued to arise where free trade law prevents nations from regulating the flow of industrial goods and services, so that nations are disabled from barring imports of environmentally-unfriendly products and deterred from regulating mobile industries that might relocate to avoid burdensome national regulations. *Cf.* Revesz, *supra* note 274 (doubting that interjurisdictional mobility induces jurisdictions to reduce their environmental protection standards).

403. *See* DUDEK & WIENER, *supra* note 206, at 19; Vivien Foster & Robert W. Hahn, *Designing More Efficient Markets: Lessons from Los Angeles Smog Control*, 38 J.L. & ECON. 19, 33 (1995); Robert N. Stavins, *Transaction Costs and Tradeable Permits*, 29 J. ENVTL. ECON. & MGMT. 133, 133-48 (1995).

404. *See* DUDEK & WIENER, *supra* note 206, at 15, 20 (distinguishing these six types of transaction costs); *see also* Ayres & Talley, *supra* note 128, at 1036 (emphasizing the need to focus on the type of transaction costs).

enforcement costs.[405] Greater diversity in the spoken languages and cultures of doing business across countries than within countries will raise search and negotiation costs. Special requirements or bureaucratic procedures in different countries may raise approval costs. The political risk of confiscatory or other adverse actions by abatement project host governments will raise insurance costs.

The transaction costs of joint implementation and Clean Development Mechanism (JI/CDM) activities under the Climate Change Convention and Kyoto Protocol seem likely to be particularly high. Partners are difficult to identify, each negotiation is novel, and each project must be pre-approved by both the host government and the investor government (and perhaps the Clean Development Mechanism Executive Board or its agents as well).[406] Moreover, JI/CDM investors support entire abatement projects, so that each investor bears a large risk of project failure.[407] Furthermore, joint implementation credit is unavailable during the pilot phase. These transaction costs may well be the dominant reason for the paltry record of joint implementation to date.[408] The transaction costs of JI/CDM could be reduced through private brokers (some of whom are already active), information exchanges, streamlined approval processes, official credit (as is available under the Clean Development Mechanism), accredited monitoring agents (e.g., environmental nongovernmental organizations), and the creation of mutual funds and other means of risk diversification.[409]

The transaction costs of a formal GHG allowance trading market would be much lower, especially if fungible allowances are traded on organized exchanges. Fungible allowances, not bearing issuer designations, would reduce insurance costs; their trade on organized exchanges would reduce search, negotiation, and approval costs. If fungible allowances are valid for bona fide purchasers, rather than depending on the underlying abatement performance of the allowance seller, then monitoring and enforcement costs would be reduced.[410] Indeed, reducing transaction costs would be a central purpose of establishing a formal allowance trading system.

Even with a formal international allowance trading system, national diversity could raise transaction costs in global markets. Many countries have legal systems that are far less "market-friendly" than the United States's. Witness the recent difficulties in spreading currency markets

405. *See supra* Subsection II.C.3.

406. *See* DUDEK & WIENER, *supra* note 206, at 41-53.

407. *See id.* at 41-53.

408. *See id.* at 52.

409. *See id.* at 52-53.

410. *See* STEWART ET AL., *supra* note 146, at 13 & n.17. Compliance by the seller would be monitored and enforced through national emissions inventories, just as under a non-trading system. *See id.* at 44-47.

around the globe.[411] Markets may be coming gradually to China, for example, but market-based environmental law will confront obstacles in China in the near term.[412] Even some industrialized democracies are considerably less market-friendly than the United States.[413] And even some otherwise market-friendly countries may find the idea of *environmental* markets to be jarring; the popularity of market-based tradeable allowances for environmental protection took many years of nurturing even in the market-oriented United States.[414] It is highly likely that a system of internationally tradeable allowances will not be matched by parallel domestic allowance trading systems—at least not immediately. Domestic implementation will use diverse instruments, and tradeable allowances at the global level will confront continuing jurisdictional encumbrances.[415]

This news is not all bad. Rather than nonmarket societies opposing globally tradeable environmental allowances, perhaps nonmarket societies might come to view international environmental markets as an entrée into participation in global markets generally. Through environmental commodity trading and associated technical assistance, these countries

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411. *See* Bhushan Bahree, *Asian Ills Stall WTO Talks To Open Financial Markets*, WALL ST. J., Sept. 19, 1997, at A8; David E. Sanger, *Asia's Economic Tigers Growl at World Monetary Conference*, N.Y. TIMES, Sept. 22, 1997, at A1; David Wessel, *The Outlook: Developing Nations Require Open Markets*, WALL. ST. J., Sept. 15, 1997, at A1.

412. *See* William P. Alford & Yuanyuan Shen, *Limits of the Law in Addressing China's Environmental Dilemma*, 16 STAN. ENVTL. L.J. 125, 136-37 (1997).

> [T]he establishment of a workable system of tradable discharge permits [in China] presume[s] more in the way of market mechanisms . . . than is now available in China or likely to be in the foreseeable future. . . . [M]any Chinese economic entities continue to operate in ways inconsistent with such market principles. Large national state-owned enterprises still occupy a prominent role in the economy [and] such enterprises include many of China's biggest polluters.

Id. The mass privatization announced at the Fifteenth Communist Party Congress in September of 1997 may have accelerated the transition to markets, but it remains to be seen whether this privatization will include sectors relevant to global environmental problems, such as the energy sector. *See* CHINA: POWER SECTOR REGULATION IN A SOCIALIST MARKET ECONOMY at xiii, 3-6 (World Bank Discussion Paper No. 361, 1997) (noting that the Chinese electric power sector remains centrally organized and state-run, and lacks well-defined property rights or market incentives for efficiency).

413. Recall the recent decision of the French Government to retain Air France as a government-run enterprise, precipitating the resignation of the Air France CEO who had sought privatization. *See Socialist Insider To Take Helm at Air France*, WALL ST. J., Sept. 19, 1997, at A8.

414. *See* Hahn & Stavins, *supra* note 2, at 3-4. Anti-environmental market rhetoric still crops up from time to time, as in Hoppe, *supra* note 217, at 39, and Sandel, *supra* note 181, at A23.

415. This is a particularly vexing problem when the market needs to be nearly universal in coverage, as would be the case for GHG allowances and other global environmental regimes. Today's international markets in currencies and capital have grown incrementally, realizing gains from trade as more countries have joined the system. But a GHG regime that did not cover most or all countries from the outset would risk significant GHG emissions leakage, with consequent adverse impacts on the regime's environmental effectiveness, on the economic competitiveness of constrained countries, and on the willingness of countries to constrain themselves in the first place. Thus, a market-based approach to global GHG control must find a way to mesh promptly with the culture and legal approach of important national governments.

could improve their capacity to participate and succeed in global markets for all kinds of commodities, services, and investments. Instead of being an obstacle to international environmental markets, confronting generalized market-unfriendliness could turn out to be an opportunity for international environmental markets to assist market-wary countries and to open the way to broader global market participation.

One way or another, the success of market-based global environment regulatory instruments will be affected by the interplay of such global markets with national legal, cultural and economic systems. Tradeable allowance systems can be expected to perform less cost-effectively in highly jurisdictional polities than in unitary polities. Still, they may perform better in jurisdictional polities than do other regulatory instruments, notably taxes. With careful design of the tradeable allowances system and with the general expansion of global markets, transaction costs can be reduced.

3. *Market Power*

The problem of market power is exacerbated in a jurisdictional implementation structure because both private firms and jurisdictions themselves can attempt to distort the market. For example, a large country with very low GHG abatement costs—say, China or Russia—might be the low-cost seller of the great majority of GHG allowances offered for trade. This country, if its allowance sellers acted as a coordinated bloc (or were formally state-owned), could exert upward pressure on allowance prices, resulting in fewer trades (but at more profit to this monopolist seller) and in less GHG abatement per aggregate expenditure than if the market were competitive. Similarly, a single large buyer of allowances, such as a single purchasing agent for a buyers' cartel, could exert downward pressure on allowance prices.

Concern about market power in domestic environmental markets is often dismissed.[416] The international GHG market would seem to be even "thicker" and more contestable than a national market, preventing the successful exercise of market power. It might look something like the U.S. SO_2 allowance trading market multiplied several-fold worldwide. But

416. *See* CLINE, *supra* note 9, at 352 (stating that the exercise of market power in a global GHG tradeable allowances system is possible but "barely conceivable" and likely to be "considerably less feasible than the only modestly successful past efforts of OPEC"); Robert W. Hahn, *Market Power and Transferable Property Rights*, 99 Q.J. ECON. 753, 764 (1984) (citing others' dismissal of market power concern); Walter S. Misiolek & Harold W. Elder, *Exclusionary Manipulation of Markets for Pollution Rights*, 16 J. ENVTL. ECON. & MGMT. 156, 164 (1989) (stating that others have dismissed the potential for strategic market manipulation by dominant firms). Both the Hahn and Misiolek articles demonstrate, however, that market power can, in fact, be a problem in tradeable emissions allowance markets. *See* Hahn, *supra*; Misiolek & Elder, *supra*.

concentrated power over allowance prices could arise on the sellers' side (e.g., a large single seller, a "GHG OPEC," or a G-77 sales agent) or on the buyers' side (e.g., a central sole purchasing agent for industrialized countries). Models of international GHG allowance trading markets suggest that Russia would be a dominant seller of allowances in an Annex I (industrialized country) GHG trading system, and that China would be a dominant seller in a global GHG trading system.[417] One recent study suggests that in an Annex I trading system, Russia and the Ukraine could raise allowance prices by about ten percent above the competitive equilibrium.[418] The problem of market power would be especially severe if a country that is a dominant player had a state-run energy sector, so that the world faced a monopoly actor with a political agenda. This could be the case with China, if it retains de facto state supervision of its energy sector.[419]

Market power could also distort the incremental expansion of an initially subglobal treaty using tradeable allowances. Every new country admitted to the treaty could have an effect on allowance prices. For example, suddenly adding China or Brazil to an initially Annex I only market could depress allowance prices (or it might remedy Russian market power). Opt-ins might need to be brought on board in sets of countries whose demand and supply profiles would be neutral with respect to prices, or would redress imbalances in prices.[420] Hence, there would likely be some voting procedure for the admission of opt-ins, and group members might have strategic incentives to enlist or exclude different opt-ins. Ordinarily, additional countries can accede to an existing treaty without any say from current treaty members, but in a market-based treaty in which new members could substantially affect the price of allowances, this prospect would invite some method for managing entry to the market. The voting rules for allowing opt-ins might need to require less than consensus, in order to

417. *See* Hourcade et al., *supra* note 70, at 341 & fig.9.28 (showing China as a dominant seller in a global market); Hege Westkog, *Market Power in a System of Tradeable CO_2 Quotas*, 17 ENERGY J. 85 (1996) (showing Russia and the Ukraine as dominant sellers in an Annex I market).

418. *See* Westkog, *supra* note 417, at 99 n.14.

419. *See* Edward A. Gargan, *Weakness Seen in China's Economic Boom*, N.Y. TIMES, Sept. 19, 1997, at A5; *supra* note 412. Official state ownership of many businesses in China may be on the wane. *See* Seth Faison, *Major Shift for Communist China: Big State Industries Will Be Sold*, N.Y. TIMES, Sept. 12, 1997, at A1 (reporting plans of Chinese President Jiang Zemin and the 15th Communist Party Congress to privatize more than 10,000 of China's 13,000 state-owned enterprises). But the energy extraction and power generation industries may remain state-owned, or at least de facto state-controlled and monolithic. *See supra* note 412. Even in the United States, electric utility deregulation is quite recent and controversial. *See* Edward A. Smeloff, *Utility Deregulation and Global Warming: The Coming Collision*, 12 NAT. RESOURCES & ENV'T 280, 284-85 (1998). The lucrative nature of GHG allowance sales could make them a tempting asset for state control. *See supra* notes 174-177 and accompanying text (describing potentially large financial value of international trade in GHG allowances).

420. *See* STEWART ET AL., *supra* note 146, at 48.

avoid one country exercising market power through its ability to veto a candidate opt-in.[421] An alternative approach would be for opt-ins to be admitted automatically upon satisfaction of certain objective criteria, rather than to be subject to individualized votes. Better yet, every country could be included from the outset, with a sliding scale of increasing constraints as, say, national income rose over time.[422] Or the treaty's coverage could be global from the outset, as favored in Part II above.

A different form of market power could arise if certain parties possess asymmetric information about abatement options or about how to play the market. Countries with fewer trained economists and less active domestic markets may fear being outmaneuvered by countries with hordes of economists and robust, aggressive market sectors. This problem may be at the root of developing countries' fears that an international market in allowance trading would enable "carbon colonialism" as industrialized countries "skim the cream" by buying up the best abatement options at low prices, leaving developing countries only less attractive options to employ.[423] This fear counsels investment by neutral parties in capacity building to assist developing countries toward effective participation in the allowance trading market.[424]

There may also be a tension between efforts to reduce transaction costs and concerns about market power. Some have suggested reducing transaction costs, particularly search costs, by putting all joint implementation investment funds in the hands of a single central investment manager, such as the World Bank.[425] The Kyoto Protocol's coronation of

421. There is some precedent for incremental modification of treaties without universal assent. "Adjustments" to the phase-out schedules and relative ozone-depleting potential ratings of controlled chemicals under the Montreal Protocol require separate 2/3 votes of industrialized and developing countries, but the decisions are then binding on all parties. *See* Montreal Protocol, *supra* note 34, at art. II(9)(c), 26 I.L.M. at 1554. By contrast, "amendments," which can add new chemicals to be controlled or change the trade restrictions on controlled chemicals, require a 2/3 vote but cannot bind dissenters. *See* Vienna Convention, *supra* note 32, at arts. 9(3),(4),(5), 26 I.L.M. at 1533. Of course, dissenters from "adjustments" could withdraw from the entire treaty, but the costs of full withdrawal may typically exceed the costs of acceding to the adjustments.

422. *See* William Nordhaus, Climate Allowances Protocol (CAP): Comparison of Alternate Global Tradeable Emissions Regimes 10 (Aug. 13-14, 1997) (unpublished manuscript, on file with *The Yale Law Journal*).

423. *See* Harvey & Bush, *supra* note 162, at 14, 39 (stating that developing countries fear that joint implementation "might exploit the weakness of developing countries or perpetuate neocolonial relationships"); Laura H. Kosloff, *Climate Change Mitigation and Sustainable Development*, 12 NAT. RESOURCES & ENV'T, Fall 1997, at 93, 95 (noting that many countries are "concerned that industrialized countries will absorb the most cost-effective mitigation opportunities, many of them in developing countries, thereby reducing those countries' future mitigation options when they then need them as part of their economic development plans"). Absent asymmetric capacity to participate in the allowance market, the fear of "cream skimming" seems illusory: Countries would not sell allowances for less than the present value of the future opportunity to emit. If abatement options would be more valuable in the future, the price of the allowance would rise today to cover that option value. Thus, asymmetric capacity is the real issue.

424. *See supra* note 180.

425. *See, e.g.*, Fisher et al., *supra* note 70, at 419.

the Clean Development Mechanism as the exclusive route for purchasing GHG credits from developing countries, run by a central Executive Board,[426] threatens to achieve just such a result (though the World Bank may not be the manager of the Clean Development Mechanism). A single sales agent for developing countries is also conceivable; perhaps this is what the Clean Development Mechanism will become. But such moves to funnel allowance trades with developing countries through a central gatekeeper could create a bottleneck in abatement investments and stifle competition among investors and hosts. The central role and market power of the Clean Development Mechanism, either as a monopolist for developing countries or a monopsonist for industrialized countries, will likely foster an intense and wasteful political struggle over its leadership and operation.

A better route is to use formal fungible allowances to reduce transaction costs and to manage market power by ensuring a "thick" market of numerous participants with a wide range of abatement costs. Article 12(9) of the Kyoto Protocol does authorize private parties to be involved in the Clean Development Mechanism,[427] so—short of abolishing the Clean Development Mechanism and including developing countries in formal allowance trading—the best path for the Clean Development Mechanism would be for it to serve a "market maker" role: publicizing opportunities for hosts and investors, ensuring that developing countries are well-informed and well-equipped to participate in the market, and acting as the registry for transactions in "certified emission reductions" from developing countries. This "market maker" role would sidestep the problems of delay and market power that could arise if the Clean Development Mechanism tries to exercise decisionmaking authority over project selection, investments, and credit transfers.

Market power is more of a concern in the international arena under a jurisdictional implementation structure for a final reason: the lack of antitrust law to remedy the emergence of market power. Unlike domestic antitrust or competition law, there is no international legal framework to combat market power—there is no international antitrust law.[428] In the

426. *See* Kyoto Protocol, *supra* note 41, art. 12, 37 I.L.M. at 38.

427. *See id.*

428. *See* Eleanor M. Fox, *Toward World Antitrust and Market Access*, 91 AM. J. INT'L LAW 1, 3 (1997). Even under U.S. antitrust law, market power exercised by the subsidiary political jurisdictions (the states) is largely exempt from federal control under the "state action" doctrine. *See* Parker v. Brown, 317 U.S. 341, 350-52 (1943); John Shepard Wiley Jr., *A Capture Theory of Antitrust Federalism*, 99 HARV. L. REV. 713, 714-15 (1986). The analog at the global level would be to prosecute market power exercised by private monopolies and cartels but to leave nation-state-run enterprises immune from antitrust liability. Such an exemption would immunize the nation-state-run energy and forestry sectors, such as the Chinese state-run energy sector, which might exercise distortionary market power in global environmental markets.

domestic setting, antitrust law can remedy market interference.[429] It can also be politically salient in reassuring decisionmakers ex ante that market power will be held in check. For example, when market power was voiced as a concern in the design of the U.S. SO_2 trading market, the response was that the market would be thick enough, and that in any case the antitrust laws would be available.[430] At the international level, perhaps a new global competition law could be created,[431] or perhaps a customized competition law could be drafted to govern just the GHG allowance market.[432] Without effective international antitrust laws, safeguarding open competition in an international allowance trading market would have to rely on thickness (as other international markets must), on extensions of national antitrust laws, and on bilateral agreements to reciprocate under national antitrust laws.[433]

Though market power is a more serious concern in a jurisdictional structure than in a unitary structure, the relevant question for global environmental regulatory policy is the effect of market power on tradeable allowances compared to the effect of the jurisdictional structure on alternative instruments, chiefly taxes. The exercise of market power in quantity-based environmental allowance markets is not as serious a problem as the distortions of tax instruments introduced by domestic cushioning strategies. Market power affects only the price of allowances and not the quantity of emissions,[434] whereas domestic cushioning affects both costs and emissions. Moreover, market power may be mitigated by a "thick" market and by the development of specific or generic international antitrust law.

D. *Implications*

This Part has shown that the move from a unitary polity to a decentralized jurisdictional implementation structure poses problems for all

429. *See* Revesz, *supra* note 103, at 468 (asserting that monopoly behavior in tradeable allowance markets "would certainly be illegal under the antitrust laws").

430. Congress deemed this backstop function important enough that it specifically provided for the applicability of the antitrust laws to the SO_2 trading market in the Clean Air Act amendments. *See* 42 U.S.C. § 7651b(i) (1994).

431. *See The Borders of Competition*, ECONOMIST, July 4, 1998, at 69 (reporting on initial explorations of a multilateral antitrust law through the WTO).

432. *See* STEWART ET AL., *supra* note 146, at 34-35. *But see* Fox, *supra* note 428, at 4 (expressing concern about a "patchwork of antitrust policies . . . devised to fit specialized instruments of trade").

433. *See* Hartford Fire Ins. v. California, 509 U.S. 764, 769-70 (1993) (holding that U.S. civil antitrust law can apply extraterritorially); United States v. Nippon Paper Indus., 109 F.3d 1, 9 (1st Cir. 1997) (holding that U.S. criminal antitrust law can apply extraterritorially); Fox, *supra* note 428, at 13-15 (identifying four possible ways to construct international antitrust rules); Eleanor M. Fox & Janusz A. Ordover, *The Harmonization of Competition and Trade Law*, 19 WORLD COMPETITION L. & ECON. REV. 5 (1995).

434. *See* Revesz, *supra* note 103, at 468 ("[E]ven if polluters collude to lower the prices of permits, environmental quality will not be damaged [under a quantity-based constraint].").

regulatory instruments. Taxes are vulnerable to circumvention by the jurisdictions' internal cushioning strategies—subtle and essentially unmonitorable changes in domestic tax and subsidy rules that shield regulated industries. Because technology standards and taxes do not cap total emissions, such cushioning strategies can distort not only local costs and international competitiveness but also the level of global externalities. Although cushioning strategies could also be attempted under tradeable allowances, the quantity constraint inherent in this instrument would prevent such cushioning from distorting the level of global environmental protection. Meanwhile, although the problems posed by a jurisdictional implementation structure for tradeable allowances—such as protectionist barriers to trade, higher transaction costs of trading across jurisdictions, and market power exercised by jurisdictions' governments or state-run enterprises—are significant, they are much more amenable to generic institutional reforms intended to promote open global markets. And because these reforms are valuable for facilitating global markets generally, with or without the advent of global environmental markets, they can be expected to be adopted in any event as the globalization of world markets progresses.[435] Indeed, whereas global free trade has been alleged by some to be a threat to national environmental protection,[436] it can be an important *supportive* element in the emergence of efficient global environmental protection regimes.[437]

In the choice between price and quantity instruments, a jurisdictional implementation structure is likely to be more problematic for price instruments. The problem of unmonitorable domestic fiscal cushioning strategies is far more intractable than are the problems of interjurisdictional trade barriers and market power, and the latter will likely be eased in any case by the ongoing globalization of general market institutions. Here again, the underlying legal framework significantly affects the choice of optimal regulatory instrument, and tradeable allowances enjoy a presumptive advantage over taxes at the global level.

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435. In addition, choosing the most participation-efficient regulatory instrument, as discussed in Part IV, may have a helpful symbiotic effect on the jurisdictional problems discussed in Part V. As shown in Part IV, tradeable allowances with quantity-based side payments would help maximize participation without perverse results. As participation expands, the market for externality abatement becomes thicker. A thicker market, in turn, helps reduce the global marginal cost of abatement, reduce leakage, reduce transaction costs, and prevent the exercise of market power. Thus, to some extent, adoption of allowance trading to meet the demands of the Voluntary Assent voting rule would also help ameliorate the potential problems of jurisdictional implementation.

436. *See supra* note 402.

437. From this perspective, admitting China to the WTO might be more than a possible partial side payment to help attract China to sign on to GHG emissions constraints; it might also be a crucial move to ensure that China's participation in a global GHG allowance trading market does not bring with it barriers to allowance trades, high transaction costs, and Chinese exercise of market power.

VI. CONCLUSION

The debate in law and economics over regulatory instrument choice—command-and-control technology requirements, price-based liability rules and taxes, and quantity-based property rules and tradeable allowances—has to date been conducted within the comfortable confines of a single legal framework. In that assumed world of "Unitary Fiat," the regulatory instrument is chosen by a single rational actor who can impose regulation directly on sources. Where the legal framework allows direct coercion of sources, then taxes and liability rules may be superior to tradeable property rule entitlements. This is the standard result of much law and economics analysis.

Global environmental regulation, however, occurs under a quite different legal framework, in which regulation is adopted by the voluntary assent of the regulated entities and is implemented through intermediary political jurisdictions. When comparing regulatory instruments for global environmental problems, we need to think "outside of the box" of Unitary Fiat. The central finding of this Article is that the underlying legal framework powerfully affects the choice of optimal regulatory instrument.

In particular, the Voluntary Assent voting rule and the jurisdictional implementation structure both confer important presumptive advantages on quantity-based tradeable allowances over taxes, subsidies, or conduct-based technology instruments. Under the Voluntary Assent voting rule, "participation efficiency" becomes a central attribute of regulatory instrument choice. With diverse net benefits of cooperation across sources, instruments such as technology requirements, fixed quantity standards, and taxes are all likely to yield high costs of nonparticipation. Subsidies to attract participation (or combined tax-and-pay approaches) will yield high costs of securing participation, notably perverse moral hazard incentives toward increasing overall environmental damage. Quantity-based tradeable allowances, with side payments built into the allowance assignment can attract participation while suppressing these perversities, and are thus more participation-efficient than the other instruments. Meanwhile, under a jurisdictional implementation structure, taxes are comparatively more vulnerable to unmonitorable domestic fiscal cushioning games. Quantity-based tradeable allowances avoid the environmental distortions of these cushioning strategies.

Global environmental protection should, therefore, presumptively favor quantity-based tradeable allowances, unless other policy attributes, such as performance under uncertainty or high transaction costs, persuasively overcome the presumptive advantage of the cap-and-trade approach. The Kyoto Protocol and the Montreal Protocol should be reevaluated in terms of participation efficiency. Future international environmental accords should

typically employ quantity-based tradeable allowances to engage widespread participation without inducing perverse behavior.

The implications of this analysis extend beyond the global context to any polity in which the voting rule and implementation structure vary from Unitary Fiat. Participation efficiency is relevant to the regulation of nuisances in neighborhood associations that require voluntary assent to restrictive covenants, and even to regulation under Majority rule when side payments are necessary to build the majority coalition or defuse opposition. Indeed, this analysis may reveal a new explanation for the choice between Pigouvian and Coasean remedies. Corrective taxes and liability rules may be superior in a direct and coercive legal system, but tradeable property entitlements may be superior in a decentralized and consensual legal system. The "law" in law and economics deserves closer attention.

The modern terms "ecology" and "economics" are both derived from the ancient Greek word "oikos," meaning "house."[438] Ecology and economics are society's disciplines for managing our collective household. We now live in a global house, bound together by both global ecological interdependence and global economic interdependence. But despite the wisdom that "a house divided cannot stand," our two modern versions of *oikos* are often cast as adversaries and seldom united in a mutually reinforcing structure. Reconstituting ecology and economics is the project of economic incentive instruments for environmental protection. These instruments seek to harness market forces in the service of environmental protection and incorporate environmental values into market transactions. Market-based global environmental law could add a new global property law dimension to the world economy—a "green currency" that could transform international financial flows toward financing environmentally friendly development in poorer countries. By bringing market economics to global environmental protection and bringing environmental protection to global economic markets, market-based international environmental law could help heal the rift between environment and development, north and south, environment and trade—in short, *oikos* versus *oikos*.

We may be in the midst of a Demsetzian transition[439] at the global frontier. Formal global environmental allowance markets can be seen as a

438. *See* NASH, *supra* note 185, at 55. The term "oecologie" was coined by the evolutionary biologist Ernst Haeckel in 1866, and the spelling "ecology" appeared in the 1890s. *See id.*

439. *See* Demsetz, *supra* note 254, at 350-52, 357-58 (describing how and why property rights regimes emerge); Merrill, *supra* note 51, 1017-19 (invoking Demsetzian thesis in the context of transboundary pollution); *see also* DOUGLASS C. NORTH, INSTITUTIONS, INSTITUTIONAL CHANGE AND ECONOMIC PERFORMANCE 83-104 (1990) (describing institutional change as typically comprising marginal adaptations to the "complex" of rules, norms and enforcement that constitute the institutional framework); Oliver E. Williamson, *Transaction-Cost Economics: The Governance of Contractual Relations*, 22 J.L. & ECON. 233, 241 (1979) (discussing the need for adaptation to changing market circumstances).

next step in the Demsetzian process of developing property market institutions to internalize the externalities of overuse, conserve the value of unowned social resources, and thereby improve social well-being. The heretofore open-access global atmosphere is being transformed into a limited-access transferable property rights regime. The creation of tradeable allowances—"regulatory property"—represents a legal parceling of the property rights to use valuable resources.[440] They are a meta-market response to the incompleteness of status quo markets. As Demsetz observed, demand for the institution of environmental property rights rises as the value of controlling externalities grows and the cost of establishing and enforcing such a property rights regime declines.[441] But the Demsetzian transition does not occur exogenously, a *deus ex machina* arriving on the scene just in time to avert environmental tragedy. It is an endogenous process that depends on our own decisions and creativity.[442] As we are now beginning to construct global property institutions, such as internationally tradeable allowances, to fence and protect the global commons, we must choose our institutional architecture with care. The success of this construction project—of rebuilding our global *oikos*—will depend critically on our choice of regulatory tools.

440. *See* Carol M. Rose, *The Several Futures of Property: Of Cyberspace and Folktales, Emission Trades and Ecosystems*, 83 MINN. L. REV. 129, 163-66 (1998); Richard B. Stewart, *Privprop, Regprop, and Beyond*, 13 HARV. J. L. & PUB. POL'Y 91, 93 (1990).

441. *See* Demsetz, *supra* note 254; Keohane, *supra* note 233; Merrill, *supra* note 51, at 972-73.

442. *See* NORTH, *supra* note 439.